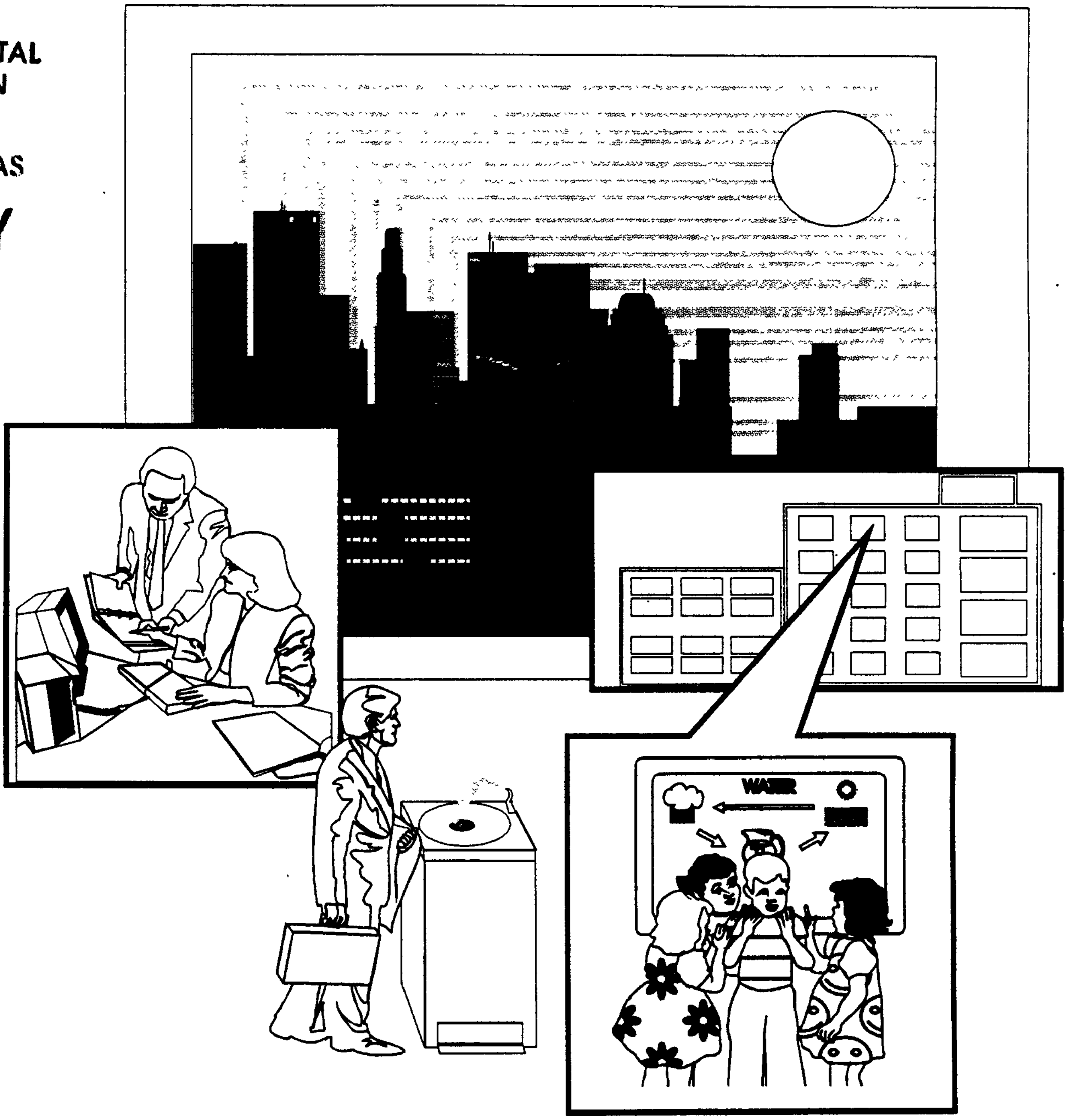
United States Environmental Protection Agency
Office of Water 4604
EPA 812-B-94-002
April 1994

Lead in Drinking Water in Schools and Non-Residential Buildings



Printed on Recycled Paper

Contents

About This Manual

The purpose of this manual is to demonstrate how drinking water in schools and non-residential buildings can be tested for lead and how contamination problems can be corrected if found. This manual is intended for use by officials responsible for the maintenance and/or safety of these facilities.

Exposure to lead is a significant health concern, especially for young children and infants whose growing bodies tend to absorb more lead than the average adult. Pregnant women and fetuses are also vulnerable to lead in addition to middle-aged men and women.

Drinking water represents one possible means of lead exposure. Some drinking water pipes, taps, and other outlets (i.e., an apparatus dispensing water) in homes and buildings may contain lead. The lead in such plumbing may leach into water and pose a health risk.

The longer water remains in contact with leaded-plumbing, the more the opportunity exists for lead to leach into water. As a result, facilities with on again/off again water use patterns, such as schools and businesses, may have elevated lead concentrations.

Even though water delivered from your community's public water supply must meet Federal and State standards for lead, you may still end up with too much lead in your drinking water because of the plumbing in your facility and because of the building's water use patterns. The only way to be certain that lead is not a problem in a particular home, school, or building is to test various drinking water outlets (i.e., taps, bubblers, coolers, etc.) for the substance. If lead problems are found, they can then be corrected.

This manual is intended to aid you as the concerned school and non-residential building official in determining whether your facility has a lead-in-drinking-water problem. This manual is designed to provide you step-by-step instructions for sampling your water for lead and correcting lead problems when found. In addition, the manual provides background information concerning the sources and health effects of lead, how lead gets into drinking water, how lead in drinking water is regulated, and how to communicate lead issues with users of your facility (e.g., employees, students, concerned parents).

If you are not the individual responsible for testing and correcting lead problems in your facility, please forward this manual to the appropriate person(s). If you are connected with a school, responsible staff might include superintendents, principals, physical plant managers, or science department chairpersons. If you are associated with a non-residential building, responsible staff might include building owners or management agents.

Part 1
Lead in Drinking Water Overview

Section 1 Background Information

This section provides general information concerning the health effects of lead, how lead is used and distributed in the environment, how lead gets into drinking water, why it may be a problem in your facility, and, finally, how lead in drinking water is regulated. This background information should provide you with a framework for embarking upon your own lead testing program.

Health Effects of Lead: Why You Should Be Concerned

Lead is a toxic metal that can be harmful to human health when ingested or inhaled. Even small doses of lead can be harmful. Unlike most other contaminants, lead is stored in our bones, to be released later into the bloodstream. Thus, even small doses can accumulate and become significant. The groups most vulnerable to lead include fetuses and young children.

Pregnant Women and Fetuses: Accumulated lead stored in mothers may damage a child before it is born, causing a lower birth weight and slowing down normal physical and mental development. Recently published studies suggest that even low levels in a mother may later affect an infant's mental performance.

Young Children: Young children, especially those under the age of six, are particularly sensitive to the effects of lead. Because their bodies are still developing, small children process lead differently than adults. Their growing bodies tend to absorb more lead than an adult. Thus, lead can affect them at smaller doses. Even at low levels of lead exposure, children may experience lower IQ levels, impaired hearing, reduced attention span and poor classroom performance. At high levels, lead can seriously damage the brain.

Middle-aged Men and Women: Some recent studies have found an association between blood-lead levels and slight increases in blood pressure among adults. The relationship is more marked in middle-aged men but is also significant for middle-aged women. The significance of any lead-related increases in blood pressure in connection to more serious cardiovascular diseases remains to be determined.

The degree of harm from lead exposure depends on a number of factors including the frequency, duration, and dose of the exposure(s) and individual susceptibility factors (e.g., age, previous exposure history, nutrition and health). In addition, the degree of harm depends on one's total exposure to lead from all sources in the environment—air, soil, dust, food, and water. Lead in drinking water can be a significant contributor to overall exposure to lead, particularly for infants whose diet consists of liquids made with water, such as baby food formula.

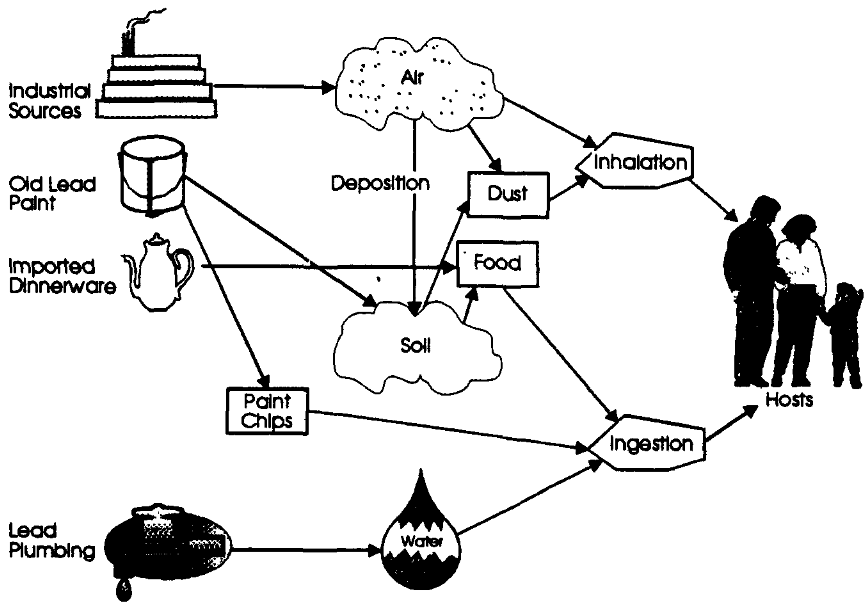


Exhibit 1 Distribution and Uses of Lead

Distribution and Uses of Lead

Lead is distributed in the environment through both natural and man-made means. Today, the greatest contributions of lead to the environment stem from past human activities. As illustrated in Exhibit 1, sources that produce excess lead exposure include the following:

- **Lead based paint** (which can flake off onto soil or be ingested by children).
- **Lead in the air** (from industrial emissions).
- **Dust and soil** (lead deposits in soils around roadways and streets from past emissions by automobiles using leaded gas, together with paint chips and lead paint dust, find their way into the mouths of young children living in polluted environments).
- **Lead in food** (deposed from air onto crops or lead glaze on imported dinnerware).
- **Lead dust** (brought home by industrial workers on their clothes and shoes).
- **Lead in water** (through corrosion of plumbing products containing lead).

The U.S. government has taken steps over the past several decades to dramatically reduce new sources of lead in the environment (e.g., by banning the manufacture and sale of leaded paint, by phasing out lead additives in gasoline, and by encouraging the phaseout of lead seams from food cans). More recently, the government has begun to attack existing sources of lead in the environment. For example, programs have been instituted to minimize the hazards posed by old lead paint covering millions of homes across the United States, more stringent air control standards are being applied to industries emitting lead, and more stringent regulations are in place to control lead in drinking water.

How Lead Gets into Drinking Water

Lead can get into drinking water in two ways: (1) by being present in the water entering the treatment plant (i.e., source water) or (2) through an interaction of the water and plumbing materials containing lead (i.e., through corrosion).

At the Source

Most sources of drinking water have no lead or very low levels of lead (i.e., under 5 parts per billion). However, lead naturally occurs in the ground and in some instances can get into well water. Lead can enter surface waters (e.g., waters from rivers, lakes, streams) through direct or indirect discharges from industrial or municipal wastewater treatment plants or when lead in air settles into water or onto city streets and eventually, via rain water, flows into storm sewers. Lead from these sources can be easily removed by existing treatment plant technologies.

Through Corrosion

Most lead gets into drinking water after the water leaves the local treatment plant or private well and comes into contact with plumbing materials containing lead. The physical/chemical interaction that occurs between the water and plumbing is referred to as corrosion. The extent to which corrosion occurs contributes to the amount of lead that can be picked up by the drinking water.

As illustrated in Exhibit 2, drinking water comes into contact with plumbing materials that may contain lead once the water leaves the treatment plant. Some lead may get into the water from the distribution system — the network of pipes that carry the water to homes, businesses and schools in the community. Some communities have lead components in their distribution systems (i.e., lead joints in cast iron mains, pipes, service connections, pigtails and goosenecks). However, the public water supplier is responsible for making sure that the distribution system under the utility's control does not contribute harmful amounts of lead. *See "How Lead in Drinking Water is Regulated" in this section for further information on this topic.*

Interior plumbing, soldered joints, and various drinking water outlets that contain lead materials are the primary contributors of lead in drinking water. Pictures of some of the common drinking water outlets are reflected in Exhibit 3. *The glossary in Appendix B provides definitions of the various drinking water outlets discussed in this document.*

The critical issue is that even though your public water supplier may send you water that meets all Federal and State public health standards for lead, you may end up with too much lead in your drinking water because of the plumbing in your facility. That is why testing water from your drinking water outlets for lead is so important.

Factors Contributing to Corrosion

What causes lead to possibly leach from your plumbing into drinking water? Actually, no single situation or activity causes this interaction. Rather, it is a combination of several factors. The corrosion of lead tends to occur more frequently in "soft" water (i.e., water that lathers soap easily) and acidic (low pH) water. Other factors, however, also contribute to the corrosion potential of the water and include water velocity and temperature, alkalinity, chlorine levels, the age and condition of plumbing, and the amount of time water is in contact with plumbing. The occurrence and rate of corrosion depend on the complex interaction between a number of these and other chemical, physical, and biological factors.

Public water system officials routinely undertake activities aimed at controlling the corrosion characteristics of their water supplies. Their treatment activities can lead to a protective coating of minerals being formed on the inside layer of pipes, thereby insulating the drinking water, in effect, from lead. Given that the health effects of lead occur at very low levels, these activities are critical. The activities undertaken by individual homeowners and building owners/operators to identify and remove problem plumbing are also critical.

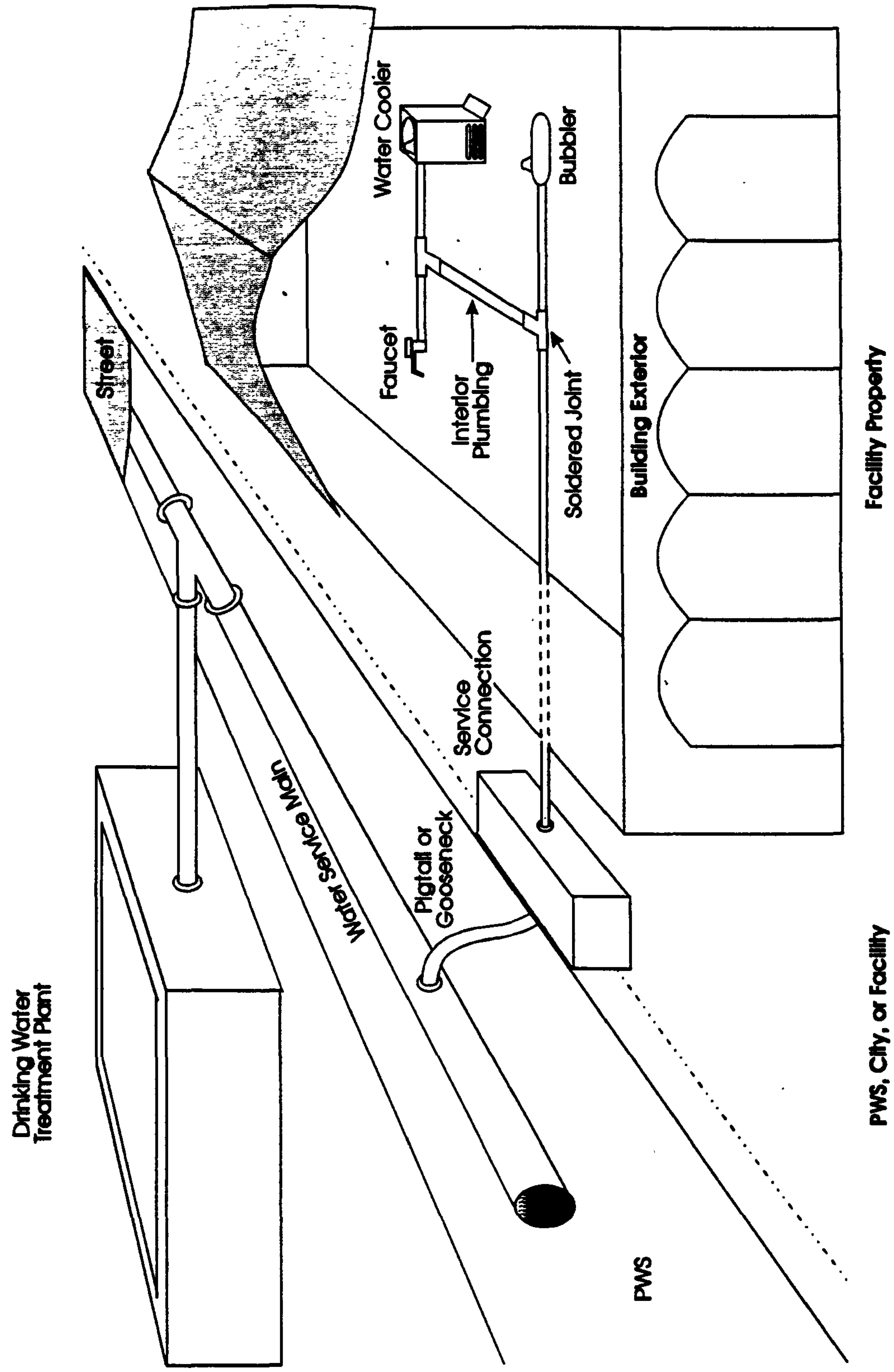
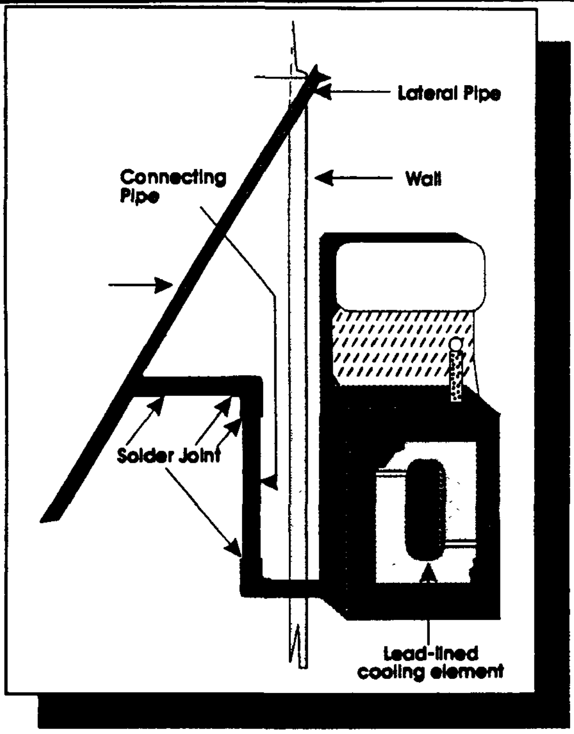
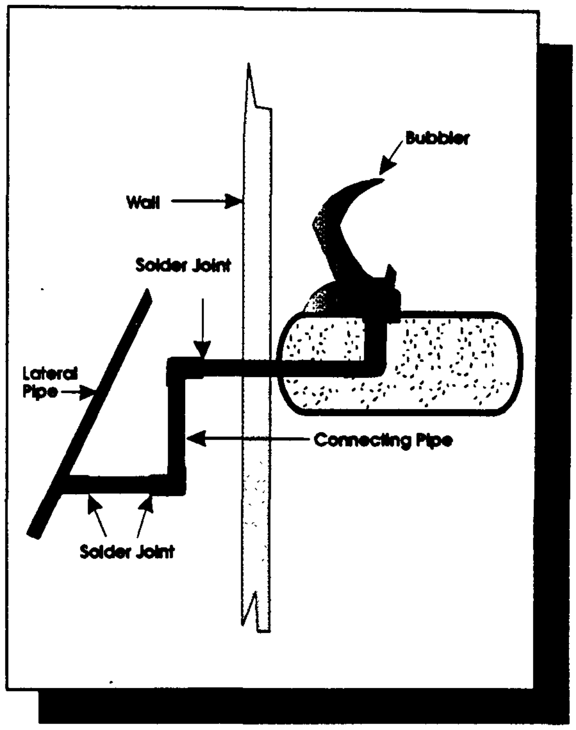


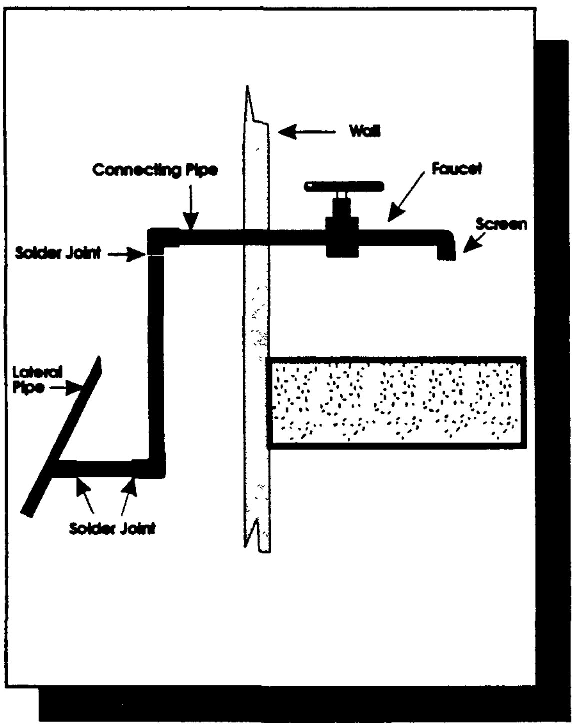
Exhibit 2 Sources of Lead in Plumbing



Water Cooler



Bubbler



Faucet (Tap)

Sources of Lead in Drinking Water

Common sources of lead in drinking water include;

- solder
- fluxes
- pipes and pipe fittings
- fixtures (e.g., brass faucets containing alloys of lead)
- sediments

Exhibit 3 Common Drinking Water Outlets

How Lead in Drinking Water Is Regulated

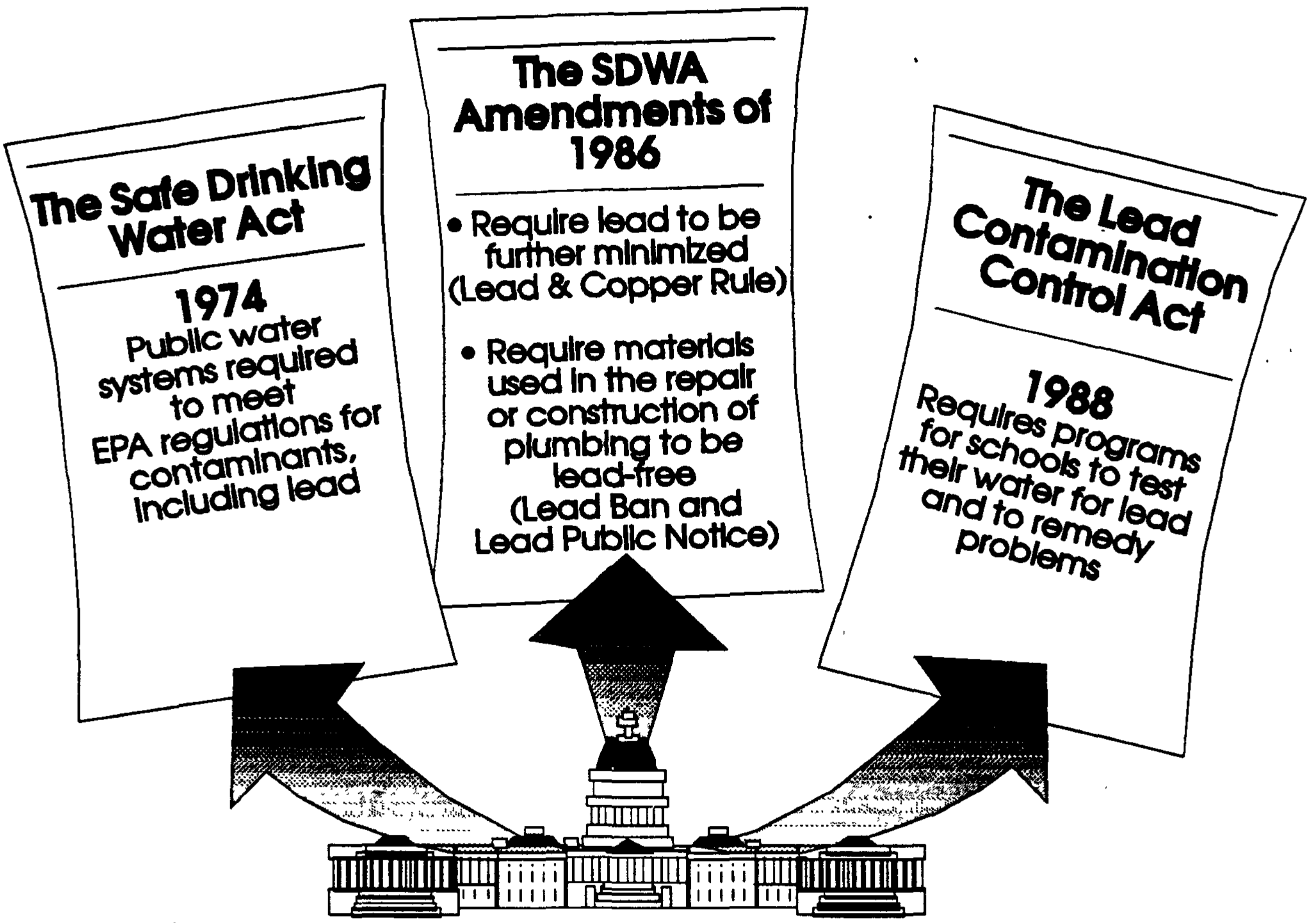
Lead is regulated in drinking water under a Federal body of law known as the Safe Drinking Water Act (SDWA). This Act was initially passed in 1974 and, in part, requires EPA to establish regulations for known or potential contaminants in drinking water for the purpose of protecting public health.

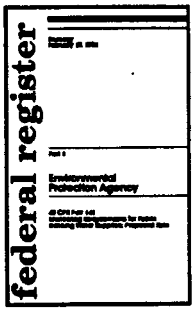
The regulations developed by EPA are aimed at public water systems. These systems are defined as those with 15 or more service connections in operation at least 60 days a year or systems serving 25 or more persons daily at least 60 days a year. *Schools or non-residential buildings that own or operate their own water supply and that meet this or the State's definition of a public water supply are subject to the provisions of the SDWA. Facilities in this position should already be knowledgeable of their legal responsibilities. Any questions in this regard should be directed to the appropriate State drinking water office. See Appendix A for a directory of State programs.*

Major amendments were passed to the SDWA in 1986. These amendments include some specific provisions for controlling lead in drinking water:

- A new regulation by EPA to minimize the corrosivity and amount of lead in water supplied by public water systems (known as the **Lead and Copper Rule**).
- A requirement that only lead-free materials be used in new plumbing and in plumbing repairs (called the **Lead Ban**).
- A one-time lead public notification requirement.

In 1988, Congress passed the **Lead Contamination Control Act (LCCA)**, which further amended the SDWA. The LCCA is aimed at the identification and reduction of lead in drinking water at schools and day care facilities.

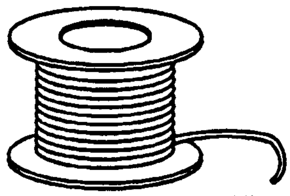




Public Water Systems Lead and Copper Rule

In June 1991, EPA revised the National Primary Drinking Water Regulation for lead (by promulgating the Lead and Copper Rule). The regulation requires public water systems to take 1-liter tap water samples at representative high-risk residences served by the system. The total quantity and dates by which the samples are to be taken are specified in the regulation and are based on the total population served by the public water system.

If 10 percent or more of the tap samples exceed an action level of 15 parts per billion (ppb) or micrograms per liter (µg/l), then the public water system must conduct additional monitoring, implement or enhance corrosion control programs, educate consumers served by the system about lead, and possibly replace lead service lines owned by the system, if they exist.



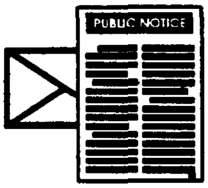
Requirement that Only Lead-Free Materials be Used in New Plumbing and in Plumbing Repairs (Lead Ban)

This provision of the SDWA requires the use of "lead-free" pipe, solder, and flux in the installation or repair of any public water system *or* any plumbing in a residential or non-residential facility connected to a public water system. Solders and flux are considered to be lead-free when they contain less than 0.2 percent lead. (Before this ban took effect in 1986, solders used to join water pipes typically contained about 50 percent lead.) The Lead Ban requires that any lead solders carry a warning label indicating that they are not to be used in connection with potable water plumbing. Pipes, pipe fittings, faucets, and other fixtures are considered lead-free under the Lead Ban when they contain less than 8 percent lead.

If you purchase your water, you may wish to contact your public water system to determine whether the system is in compliance with the National Primary Drinking Water Regulation for lead. Ask system officials to explain the results of their lead tap water sampling efforts and whether 10 percent or more of these samples exceeded EPA's action level of 15 ppb. If so, ask them what corrosion control measures are being taken to ensure that the drinking water delivered to consumers will minimize lead exposure. Your water supplier may be able to give you a good indication of what you might expect in terms of lead problems in your building, based on the utility's knowledge of the water supply and lead issues in general. Your water supplier may also be willing to assist you in conducting a lead testing program at your facility, although there is no requirement that they provide this service. *A summary of topics to discuss with your water supplier is included in the Sample Plumbing Profile Questionnaire on page 14.*

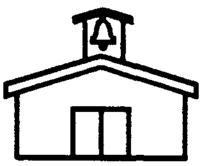
Under the Lead Ban, States were to adopt a version of the prohibition that is <u>at least</u> as stringent as the Federal version by June 1988. To date, all States have a lead-free plumbing materials requirement in place that is <u>at least</u> as stringent as the Federal version. All major national plumbing codes have also incorporated these requirements. You may wish to contact your local plumbing code officials to ascertain which code(s) is used in your area, if any. Typically, codes are required on a statewide or smaller jurisdictional basis. In any event, the codes should reflect either the national or State lead-free plumbing requirements.

As another measure, check with plumbers or contractors who are making additions or repairs to any plumbing in your facilities to ensure that only lead-free materials are being used. Test kits may be available to determine the presence of lead solder in plumbing. Any violations of the lead-free requirements should be reported to State officials *(see Appendix A)*. You should also insist that any lead materials used in new construction or recent repairs be replaced with lead-free materials.



One-Time Lead Public Notification Requirement

The SDWA also required that all public water systems provide a one-time special notice by June 1988 to educate their customers about the lead-in-drinking-water issue. The format and content of these notices were specified by EPA. The intent behind the notices was to inform consumers about the lead-in-drinking-water issue, about the steps their water system was taking to reduce opportunities for lead exposure, and about steps that could be taken in the home to minimize exposure.



The Lead Contamination Control Act (LCCA)

The LCCA required that a number of activities be conducted by Federal and other parties to identify and correct lead-in-drinking-water problems at schools and day care facilities. A listing of some of the major activities and parties responsible is provided in Exhibit 4. One principal activity to be conducted by EPA was the development of a guidance document and testing protocol that could be used by schools to determine the source and degree of lead contamination problems and how to remedy such contamination if found. This document reflects EPA's second edition of the guidance manual and testing protocol developed in response to the LCCA.

At the time the LCCA was passed, considerable attention was being given to water coolers with lead-lined tanks. The law defined these sources as "imminently hazardous consumer products." As a result, the legislation specifically stated requirements to result in the repair, replacement, or recall and refund of these water coolers and attached civil and criminal penalties to the manufacture and sale of any drinking water cooler containing lead. *See Appendix C for a summary of water cooler issues, how to identify whether you have a problem cooler, and what steps can be taken if you do.*

While the LCCA was geared toward identifying and remedying lead contamination problems in school and day care drinking water, lead may also pose problems in other buildings. EPA, therefore, advocates that the owners and/or managers of non-residential buildings also conduct testing of drinking water outlets. Since the lead testing protocol to be followed is the same for non-residential facilities as for school buildings, this guidance manual has been addressed to representatives of both facilities. EPA has a separate manual available that demonstrates how to test drinking water for lead in small nursery schools and day care facilities. In addition, EPA has a brochure for homeowners that are interested in testing their water for lead. *See Appendix D for a listing of lead testing and other information available from EPA.*

> Since some States and local jurisdictions have established programs for testing lead in schools and other buildings, it is to a school or non-residential building owner/manager's advantage to learn whether additional requirements beyond those summarized in this section exist. Consult your State or local education or drinking water program to learn whether statewide or local legislation is in effect that relates to lead testing in schools and/or non-residential buildings. *See Appendix A for a list of State contacts.*

Exhibit 4
Key Provisions of the LCCA

EPA	• Publish a list of each brand and model of water cooler that is not lead-free, including a separate list of the brand and model of water coolers with a lead-lined tank and distribute lists to States. • Publish a guidance document and testing protocol to assist schools in determining the source and degree of lead contamination in school drinking water supplies and in remedying such contamination. (Document is to, in part, include a testing protocol for identifying coolers that may contribute lead to drinking water.)
EPA and States	• Publish and make available to the public upon request a list of laboratories certified by EPA (or the State if the State has been delegated certification authority) to conduct analyses of lead-in-drinking-water.
Consumer Product Safety Commission (CPSC)	• Issue an order requiring manufacturers and importers of water coolers with lead-lined tanks to repair, replace, or recall and provide a refund for such coolers.
Water Cooler Manufacturers, Importers, and Others	• Do not sell in interstate commerce, or manufacture for sale in interstate commerce, any drinking water cooler listed by EPA or any cooler that is not lead-free, including a lead-lined cooler. (Civil and criminal penalties are associated with violations.)
States and Local Governments	• Provide for the dissemination to local educational agencies, private nonprofit elementary or secondary schools, and day care centers EPA's guidance document and testing protocol and list of water coolers. • Establish a program to assist local educational agencies in testing for and remedying lead contamination in drinking water from coolers and other sources of lead contamination at schools under the jurisdiction of such agencies. • Make available any lead testing results in the administrative offices of the local educational agency for inspection by the public, including teachers, other school personnel, and parents. • Notify parent, teacher, and employee organizations of the availability of lead testing results. • Repair, replace, permanently remove, or render inoperable water coolers that are not lead-free and that are located in schools, unless the coolers are tested and found (within the limits of testing accuracy) to not contribute lead to drinking water.

Section 2 Preliminary Assessment and General Testing Strategy

Now that you understand the potential dangers of lead contamination in drinking water and about the laws and programs in place to address this problem, it is time to consider assessing what steps you might take in your facility to identify and correct any sources of lead. The testing protocol EPA recommends that you undertake includes such activities as:

(1) Development of a plumbing profile.

(2) Development of a sampling plan.

(3) Conduct of initial and follow-up sampling and analysis of test results.

(4) Determination of interim and long-term remedies.

(5) Communication of lead testing results and, if applicable, corrective measures to the building community.

The first two activities can be considered part of the planning or building assessment stage and are described in this section. Steps 3 and 4 involve testing and correction of problems and are described in greater detail in the next two sections; the testing protocol for various types of drinking water outlets is presented in Part 2 of this document. Finally, Step 5 represents a communication activity to let those members of your building community know what you are doing to protect them from possible exposure to lead in drinking water. This subject is discussed in Section 5 of this Part.

Development of a Plumbing Profile

Before testing and correcting lead problems, it is useful to assess the factors that can contribute to lead contamination and the extent to which contamination might occur in your facility. You can best accomplish these objectives by developing a plumbing profile of your building. Conducting a survey of your building's plumbing will enable you to:

- Understand whether you may have a widespread contamination problem or only localized concerns.
- Identify and prioritize sample sites.
- Plan, establish, and prioritize remedial actions, as necessary.

Exhibit 5 consists of a questionnaire that has been designed to help you plan your testing strategy. Planning your strategy will enable you to conduct testing in a cost-efficient manner. Exhibit 6 provides interpretations of possible answers to the questionnaire to aid you in developing your sampling plan. The extent to which all questions can be answered will greatly aid you in carrying out your sampling program.

Exhibit 5 Sample Plumbing Profile Questionnaire

Sample Plumbing Profile Questionnaire

The following questionnaire will help you determine whether lead is likely to be a problem in your facility and, if so, whether these problems are likely to be localized or widespread. These determinations will enable you to prioritize your sampling effort based on those outlets you believe to pose the greatest risks. The significance of your answers to these questions is discussed in Exhibit 6 entitled, *What Your Answers to the Plumbing Profile Mean.*

(1) When was the building constructed?

(2) After the construction of the original building, were any new buildings or additions added? If so, when? If built since 1986, were lead-free plumbing and solder used in accordance with the lead-free requirements of the 1986 Safe Drinking Water Act?

(3) When were the most recent plumbing repairs made (note locations)?

(4) With what materials is the service connector made?

(5) Specifically, what are the potable water pipes made of in your facility (note the locations)?

Lead	Plastic
Galvanized Metal	Brass
Copper	Other

(6) What materials do the solders connecting the potable water pipes in your system contain (note locations with lead solder)?

(7) Are brass fittings, faucets, or valves used in your drinking water system (note the locations)?

(8) How many of the following outlets provide water for consumption (note the locations)?

Water Coolers	Bubbler
Ice Makers	Kitchen Taps

(9) What brands and models of water coolers currently provide water in your facility (note the locations)?

(10) Do the faucets have accessible screens (note locations)?

(11) Have these screens been cleaned (note locations)?

(12) Can you detect signs of corrosion, such as frequent leaks, rust-colored water, or stained dishes or laundry?

(13) Is any electrical equipment grounded to water pipes (note locations)?

(14) Have there been any complaints about bad (metallic) taste?

(15) Check building files to determine whether any water samples have been taken from your building for any contaminants (check with your public water supplier).

Name of contaminant(s)?
Were samples tested for lead?
What concentrations of lead were found?
What is the pH level of the water?
Is testing done regularly at your facility?

(16) Who supplies your facility's drinking water?

If your facility purchases its water, you should ask your public water supplier:

- Is the water supply in compliance with Federal and State standards for lead?
- What are the results of the system's tap water sampling efforts?
- Have 10 percent or more of these samples exceeded EPA's action level for systems of 15 ppb?
- What is the system doing to minimize corrosion?
- Are the system's treatment practices likely to have resulted in a protective coating being formed on the inside of water pipes in your facility?
- Does the water distribution system have any lead piping, and does the system plan to remove these sources of lead?

If your facility owns or operates its own water supply, ask the treatment operator:

- Is the supply in compliance with current Federal and State standards for lead?
- What tap samples have been taken for lead?
- What were the results of tap sampling and are there problems?
- Is the water being treated to minimize corrosion?
- For what other conditions is the water being treated?

Exhibit 6 What Your Answers to the Plumbing Profile Mean

What Your Answers to the Plumbing Profile Mean

This exhibit discusses the significance of possible answers to the plumbing profile questionnaire appearing in Exhibit 5. This discussion illustrates that a variety of factors affect the extent of lead contamination including: (1) the corrosiveness of the water supply; (2) the amount of lead contained in the plumbing, taps, or outlets dispensing water (i.e., age and condition of the plumbing); (3) the contact time between the water and the materials containing lead; and (4) whether electrical systems are grounded to water pipes.

(1) When was the building constructed?

Old Buildings—Up through the early 1900s, lead pipes were commonly used for interior plumbing in public buildings and private homes. Plumbing installed before 1930 is most likely to contain lead. Between 1920 and 1950, galvanized pipes were also used for plumbing. After 1930, copper generally replaced lead as the most commonly used material for water pipes. Up until the mid- to late-1980s (until the lead-free requirements of the 1986 Safe Drinking Water Act took effect), lead solders were typically used to join these copper pipes. The efforts of your public water supplier over the years to minimize the corrosiveness of the water may have resulted in mineral deposits forming a coating on the inside of the water pipes (scaling). This coating insulates the water from the plumbing and results in decreased lead levels in water. If the coating does not exist or is disturbed, the water is in direct contact with the lead in the plumbing system.

(2) Are there any new buildings or additions? If so, when were they built? Were lead-free plumbing and solder used?

New Buildings—New buildings are not likely to have lead pipes in their plumbing systems, but they are very likely to have copper pipes with solder joints. Buildings constructed prior to the late 1980s, before the lead-free requirements of the 1986 Safe Drinking Water Act, are likely to have joints made of lead solder. Buildings constructed after this period should have joints made of lead-free solders. You should question the solders used by plumbers who make repairs or additions to your facility. Report any violations of the lead-free requirements to your local plumbing inspector or to the state drinking water program. Furthermore, insist that any lead materials installed be replaced by lead-free materials.

Some brass faucets, fittings, and valves, although they contain less than 8 percent lead in the alloy as required under the SDWA, can contribute a significant amount of lead to drinking water. *See a more detailed discussion of this issue under the response to Question 7. Request lead leaching test results from the distributor or manufacturer before purchasing any brass plumbing materials.*

If lead-free materials were not used in new construction and/or plumbing repairs, very high lead levels can be produced. If the water is non-corrosive, scaling may have occurred (or be occurring) and will minimize lead exposure. However, if the mineral coating does not exist, the lead is in direct contact with the water.

(3) When were the most recent plumbing repairs made?

Corrosion occurs (1) as a reaction between the water and the pipes and (2) as a reaction between the copper and solder (metal-to-metal). This latter reaction is known as galvanic corrosion. The reaction can be vigorous in new piping. If lead solders were used in the piping or some brass faucets, valves and fittings containing alloys of lead were installed *(see response to Question 7 below for a further discussion of the brass issue)*, lead levels in the water may be high. After about 5 years, however, this type of reaction slows down and lead gets into water mainly as a result of water being corrosive. If the water is non-corrosive, scaling is likely to have occurred and to have reduced opportunities for lead to get into the water supply.

For these reasons, if the building (or an addition, new plumbing, or repair) is less than 5 years old and lead solder or other materials (e.g., brass faucets containing lead alloys) were used, you may have elevated lead levels. **If water supplied to the building is corrosive, lead can remain a problem regardless of the plumbing's age.**

(4) Of what materials is the service connector constructed?

Lead piping was often used for the service connectors that join buildings to public water supplies. The service connector is the pipe that carries drinking water from a public water main to a building. Some localities actually required the use of lead service connectors up until the lead-free requirements of the 1986 Safe Drinking Water Act took effect. Although a protective layering of minerals may have formed on these pipes, vibrations can cause flaking of any protective build-up and, thus, allow lead contamination to occur.

(5) What materials are used in your facility's water pipes? and

(6) What materials compose the solder connecting your pipes?

Survey your building for exposed pipes, preferably accompanied by an experienced plumber who should be able to readily identify the composition of pipes on site. Most buildings have a combination of different plumbing materials:

Lead pipes are dull gray in color and may be easily scratched by an object such as a knife or key. Lead pipes are a major source of lead contamination in drinking water.

Galvanized metal pipes are gray or silver-gray in color and are usually fitted together with threaded joints. In some instances, compounds containing lead have been used to seal the threads joining the pipes. Debris from this material, which has fallen inside the pipes, may be a source of contamination.

Copper pipes are red-brown in color. Corroded portions may show green deposits. Copper pipe joints were typically joined together with lead solders until the lead-free requirements of the 1986 Safe Drinking Water Act took effect. Full implementation of these lead-free requirements will drastically cut lead contamination in repairs and new plumbing.

Plastic pipes, especially those manufactured abroad, may contain lead. If plastic pipes are used, be sure they meet NSF International standards and are free of plasticizers that contain lead. *(Note: NSF International is an independent, third-party testing organization; copies of NSF International standards can be obtained by writing NSF International, 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, MI 48106.)*

(7) Any brass fittings, faucets, or valves?

Brass pipes, fittings, faucets, and valves are golden yellow in color, similar to copper in appearance, or plated with chrome. Brass is composed of two metals, commonly copper and zinc. Brass fittings commonly used in drinking water outlets such as faucets and water coolers, in general, contain up to 8 percent lead. While this percentage is considered lead-free under the 1986 Safe Drinking Water Act, some contamination problems still may occur. In addition, some older brass faucets may contain higher percentages of lead and lead solder in their interior construction and pose contamination problems.

The degree to which lead will leach from brass products containing alloys with less than 8 percent lead is dependent upon the corrosiveness of the water and the manufacturing process used to develop the product. A recent study comparing the lead leaching performance of several faucets manufactured under different processes and having various lead contents revealed that fabricated faucets tend to contribute less lead to the water than faucets manufactured by the permanent mold process, regardless of the amount of lead in the alloy.

EPA is working with industry and a private, third-party testing organization toward the development of a voluntary industry standard on this issue that would result in minimal amounts of lead being leached from these products. If you purchase any brass plumbing products, ask the distributor or manufacturer to provide information about tests it has performed on the product. Refrain from buying any product from a manufacturer that is unwilling to provide the testing information.

(8) What types of drinking water outlets are located in your facility?

In addition to lead components in the plumbing system, lead solders or lead in the brass fittings and valves used in some taps, bubblers, and refrigerated water coolers may be sources of lead. It is important to identify the locations of all such drinking water outlets.

(9) What are the brand and model of the water coolers?

Water coolers may be a major source of lead contamination. Under the Lead Contamination Control Act of 1988, water coolers with lead-lined tanks are considered to be imminently hazardous consumer products, and manufacturers and importers are to repair, replace, or recall these coolers. The law also requires that solder, flux, and storage tank interior surfaces in contact with drinking water contain not more than 0.2 percent lead. Other parts of water coolers that may come into contact with drinking water are not to contain more than 8 percent lead. In addition, the law attaches criminal and civil penalties for the manufacture and sale of water coolers containing lead.

The CPSC negotiated an agreement with Halsey Taylor through a consent order agreement published in June 1990 to provide a replacement or refund program that addresses all the water coolers listed by EPA as having lead-lined tanks. Halsey Taylor was the only company identified by EPA as manufacturing some water coolers with lead-lined tanks.

See Appendix C of this manual for a summary of EPA's list of water coolers found to contain lead. Use the list to help prioritize your sampling. If your water cooler is listed as having a lead-lined tank, do not use the water for drinking and sample the water immediately *(see page 63 for sampling instructions)* as these coolers pose the highest risk of contamination.

(10) Do the faucets have accessible screens? and

(11) Have the screens been cleaned?

Lead-containing sediments that are trapped on screens can be a significant source of lead contamination. Sediments should be tested for the presence of lead and the screens should be cleaned frequently.

(12) Are there signs of corrosion?

Frequent leaks, rust colored water, and stains on fixtures, dishes, and laundry are signs of corrosive water. Blue/green deposits on pipes and sinks indicate copper corrosion; brown stains result from the corrosion of iron. Where such symptoms occur, high levels of lead, copper, and iron may be present in the water.

(13) Is any electrical equipment grounded to the water pipes?

If electrical equipment, such as telephones, has been installed using water pipes as a ground, the electric current traveling through the ground wire will accelerate the corrosion of any interior plumbing containing lead. The practice should be avoided, if possible. However, if existing wires are already grounded to water pipes, the wires *should not be removed* from the pipes unless a qualified electrician installs an alternative grounding system. Check with your local building inspector on this matter. Your State or local building code may require grounding of the wires to the water pipes. Improper grounding of electrical equipment may cause severe shock.

(14) Have there been complaints about bad (metallic) taste?

Although you cannot see, taste, or smell lead dissolved in water, the presence of a bad or metallic taste may indicate corrosion and possible lead contamination.

(15) When was the water in your building last tested for contaminants, if ever?

Results of analyses of water quality, such as measures of pH, calcium hardness, and carbonate alkalinity, can provide important clues about the corrosiveness of the water. If your facility owns or operates its own water supply, such test results can help you decide on effective treatment approaches. Effective corrosion control treatment may include reducing the water's acidity, increasing its alkalinity, and/or adding a corrosion inhibitor such as zinc orthophosphate. The best choice among possible treatments will vary depending upon your water quality conditions.

If your facility purchases its water, contact your public water supplier to find out what they are doing to comply with the National Primary Drinking Water Regulation for lead. *See also the response to Question 16 below for further information.* It is important to know whether and how the water entering your facility is treated. Some kinds of treatment can make the water more corrosive, while others will reduce the problem. Treatment of public water to reduce corrosion can reduce lead levels throughout the system and can save both you and the supplier money by reducing damage to plumbing.

(16) Who supplies your facility's drinking water?
Answers to the types of questions included on the plumbing profile questionnaire will give you an idea of the type of water you are receiving. From this assessment, you will then have a better sense of how to organize your testing activities.

If your facility purchases its water, contact your public water supplier to:

- Find out whether the system is in compliance with Federal and State lead requirements.

- Learn the results of the system's latest tap water sampling efforts and whether 10 percent or more of these samples have exceeded EPA's action level of 15 ppb (i.e., what are the typical lead levels in water being delivered throughout the community).

- Learn what activities the system employs to minimize the corrosiveness of the water supply; identify what type of water you might be receiving in your facility (e.g., is it corrosive or non-corrosive water? Is the water soft or acidic?).

- Learn whether protective coatings are likely to have formed on the inside of your plumbing based on the treatment practices of the public water supplier. Identify whether the water distribution system contains lead pipes and whether/when the water system plans to remove these lead materials.

If your facility owns or operates its own water supply, you should already be aware of your legal requirements to control corrosion and minimize lead at the tap. If you are uncertain of your responsibilities, contact your State drinking water program *(see Appendix A for a directory of State programs)*. Some of the questions you might pose to the treatment operator include:

- Is the system in compliance with Federal and State requirements for lead?

- Where were tap water samples collected in the building, and what are the results of this sampling effort?

- Does the facility have a lead problem on the basis of the tap water samples?

- Is the water system being treated for corrosion purposes? Are there any other types of treatment being pursued that could contribute to lead getting into the water supply?

After reviewing the plumbing profile questionnaire and background regarding what your answers to the profile could mean (Exhibits 5 and 6), you have learned that lead contamination may not occur uniformly throughout a building. Large variations in lead concentrations may be found among individual outlets in a facility because of differences in flow rates and/or building materials.

In general, you can expect **widespread lead contamination** in your drinking water when:

- The building's plumbing is less than 5 years old and lead solder was illegally used (i.e., after the "lead-free" requirements of the 1986 Safe Drinking Water Act took effect).
- Brass fittings, faucets, and valves were installed throughout the building less than 1 year ago (even though they may contain less than 8 percent lead as required under the lead-free requirements of the Safe Drinking Water Act).
- The water is corrosive.
- Sediment in the plumbing and screens contains lead.
- Lead pipes are used throughout the building.
- The service connector (i.e., the pipe that carries water from the public water system main to the building) is made of lead.

In general, you can expect **localized contamination** if:

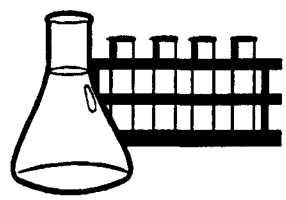
- The water is non-corrosive.
- Lead pipes are used in some locations.
- Some brass fittings, faucets, and valves have been installed in the last year (even though they may contain less than 8 percent lead).
- Numerous lead solder joints were installed in short sections of pipe before 1986 or were illegally installed after 1986 (i.e., after the lead-free requirements of the Safe Drinking Water Act took effect).
- There are areas in the building's plumbing with low flow or infrequent use.
- Sediment in the plumbing and screens at isolated locations contains lead.
- Some water coolers have lead parts or contain lead-lined tanks *(consult Appendix C for a discussion of the water cooler issue and EPA's listing of coolers)*.

Development of a Sampling Plan

After identifying potential problem areas in your facility, through completion of a plumbing profile, the next step is to have the water tested. Testing is the only sure way to know whether lead is a problem in your facility. However, it is first useful to develop a sampling plan before embarking on the actual testing. The sampling plan activity will enable you to approach taking water samples in a systematic fashion. Key issues to consider in devising a sampling plan include the following:

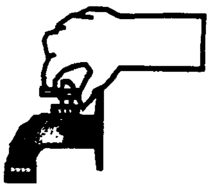
- Who will be in charge of the sampling effort?
- Who will collect and analyze samples and maintain records?
- Where will the samples be taken?

Leadership for Sampling Effort



It is important to designate a leader to take full responsibility of the sampling program and to ensure that it is conducted properly. If outside consultants or laboratory representatives are used to conduct testing, you must first ensure that they understand and are knowledgeable of the testing protocol described in this manual. Contact your State or local health department or drinking water program if you need advice on how to identify a reputable consultant.

Collection and Analysis of Samples and Recordkeeping Requirements



Deciding who will collect samples will be based, in part, on who will analyze the samples. Some State drinking water programs or public water suppliers may provide both services, although there is no requirement that they do so. In general, most facilities will need to contract with an analytical laboratory to conduct analyses of any samples collected. There are some important considerations when hiring a laboratory. First, the laboratory should be certified by the State or EPA to conduct drinking water analyses. Contact your State drinking water program *(Appendix A)* or EPA's Safe Drinking Water Hotline *(Appendix D)* for a list of certified labs in your area. Once you have identified possible laboratories, consider the following issues prior to making a selection:

- Will the lab take samples for you or will they provide training and sample containers for collectors designated by you? If you will use your own sample collectors, be certain to secure sample training from the laboratory to ensure that your test results will be reliable. Testing activities can be useless if sample collectors do not follow proper sampling procedures.

- What is the lab's knowledge of the lead testing protocol for schools and non-residential buildings? This protocol is described in the next section. Make sure laboratories thoroughly understand this protocol and do not confuse it with the lead testing protocol used by public water suppliers (for whom the labs may also work), because the two protocols are <u>different</u>. Ask the lab for references of other facilities for whom it has provided lead testing services. Contact these facilities to ascertain the quality of the lab services provided.

- What is the cost of the lab's services? Costs for laboratory analysis of samples should range between $10 and $30, depending upon the extent of the services to be provided (e.g., if only analyses are conducted or if other services such as sample collection are provided). You may want to contact several labs to compare prices and services. In most cases, labs will charge less per sample if they have numerous samples to test. You might consider combining your lead testing efforts with those of another facility to secure a possible bulk analytical rate from a particular lab.

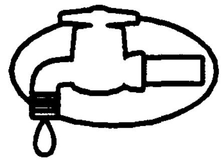
- What is the lab's time frame for providing sample results?

- What documentation will the lab provide to note sample results, and how will this material aid you in maintaining records for each outlet tested? Record keeping is a crucial activity. If lead contamination problems are found, sample records and test results will assist you in pinpointing the sources of problems. Be certain to have control over the development and maintenance of records. *Appendix E contains a sample recordkeeping form and identifies the type of information you should consider recording.*

- Establish a written agreement or contract with the laboratory for all of the services to be provided.

> Although actual costs or laboratory analysis of samples may range for $10 to $30 per sample, other costs must also be considered (e.g., costs of personnel to profile the plumbing system, design the sampling plan, collect samples, and determine and implement remedies). These costs are highly site-specific and depend on a number of factors including the size of your facility, the number of drinking water outlets being tested, and technicians' salaries. One school system in New York estimated total costs for their sampling effort to range from $2,190 to $3,295 per school. This estimate assumed 40 personnel hours for every 60 samples collected and also included lab analytical costs.

Determining Sample Locations



You must decide, based on your responses to the plumbing profile and your knowledge of the facility, where to take samples and how to prioritize the sample sites. If resources for testing are limited, this is an especially crucial step. Generally, testing should be conducted at those outlets that are most likely to have contamination since they would represent the greatest hazards to human health. Samples sites that are most likely to have lead contamination include:

- Areas containing lead pipes.
- Areas of recent construction and repair in which lead solder or materials containing lead were used.
- Areas where the plumbing is used to ground electrical circuits.
- In buildings where corrosive water having low pH and alkalinity is distributed.
- Water coolers identified by EPA as having lead-lined storage tanks or lead parts.
- Areas of low flow and/or infrequent use (where water is in contact for a long time with plumbing containing lead or with particulate matter and lead debris).

It may be helpful to diagram the plumbing in your facility and the outlets that will require testing. The configuration of interior plumbing can vary depending on the layout of a given building. Examples of plumbing configurations for a single-level building and a multilevel building are illustrated in Exhibits 7 and 8, respectively. Locate service connectors, headers, laterals, loops, drinking water fountains (bubblers and coolers), riser pipes and different drinking water loops *(see Appendix B for a glossary of these plumbing terms)*, and decide in what order you wish to take samples.

In multistory buildings, the water is elevated to the floors by one or more riser pipes. Water from the riser pipes is usually distributed through several different drinking water loops. In addition, in some buildings, water may be stored in a tank prior to distribution. In single-story buildings, the water comes from the service connection via main plumbing branches, often called headers. These, in turn, supply water to laterals. Smaller plumbing connections from the laterals and loops supply water to the faucets, drinking water fountains, and other outlets. For sampling purposes, water within a plumbing system moves "downstream" from the source (i.e., from the distribution main in the street through the service connection and through the building).

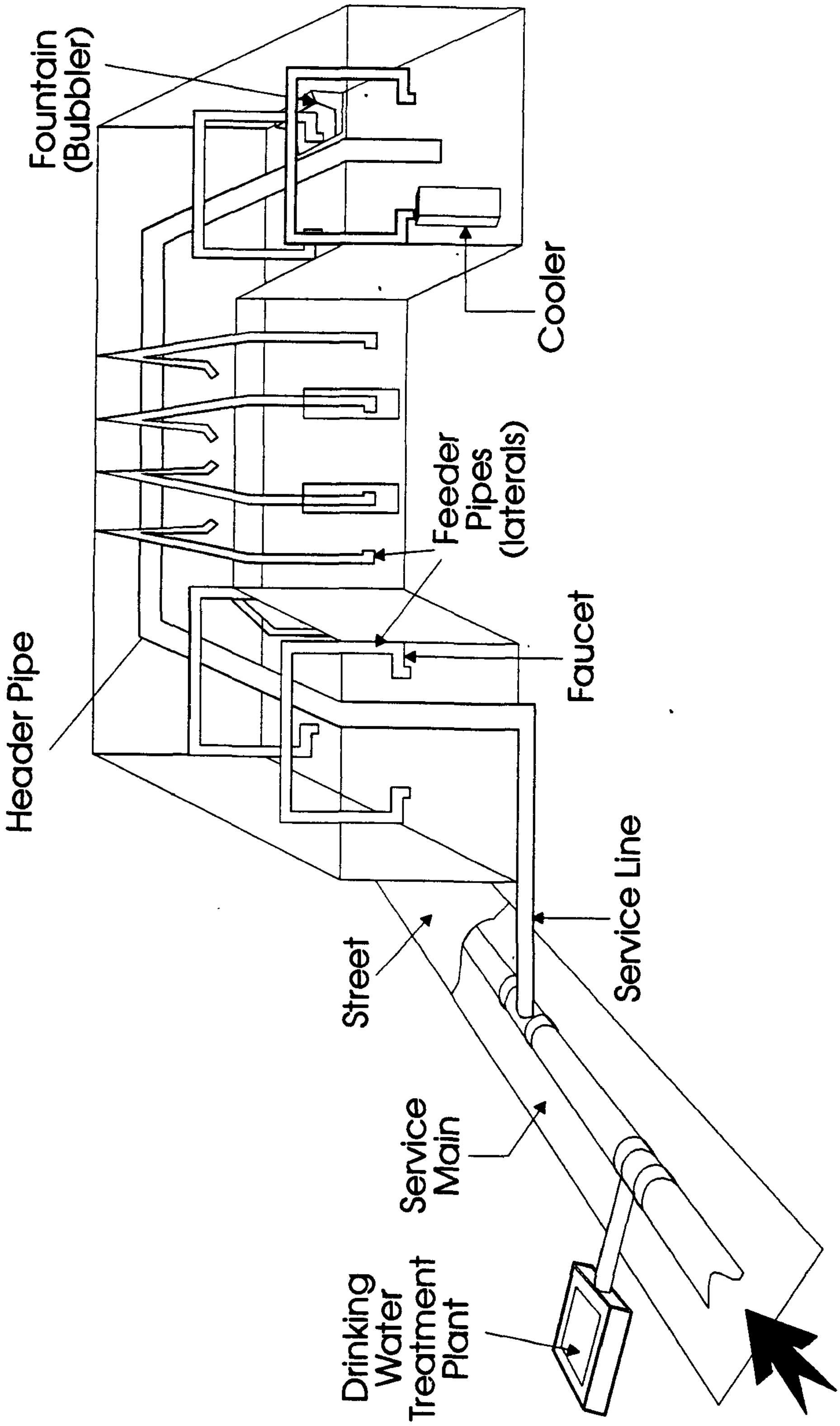


Exhibit 7 Plumbing Configuration for a Single-Level Building

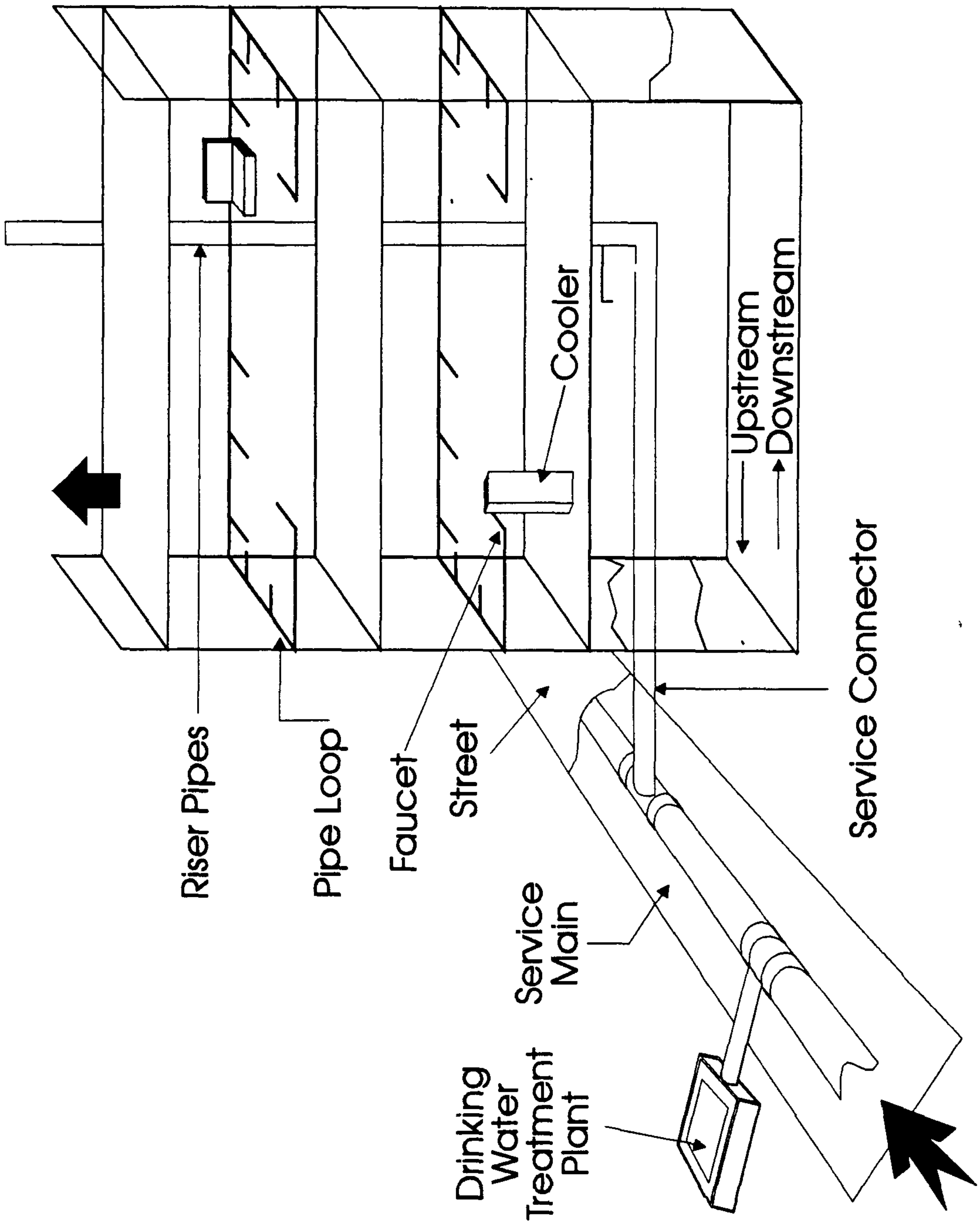


Exhibit 8 Plumbing Configuration for a Multilevel Building

Section 3
Two-Step Sampling Process

EPA recommends that a two-step sampling process or protocol be followed for identifying lead contamination, especially in large buildings where many samples are to be taken. In the first step, screening samples are collected to identify the location of outlets providing water with high lead levels. In the second step, follow-up water samples are taken from problem locations. The results of initial and follow-up samples are then compared to determine the sources of lead contamination and to determine appropriate corrective measures.

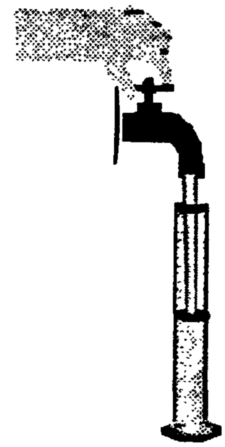
This protocol is not to be used to determine whether a water supplier meets Federal lead standards. You should be certain that any analytical laboratories or consultants conducting testing on your facility's behalf are aware that this protocol differs from the protocol to be used by public water suppliers. The protocol described in this booklet is intended to facilitate the identification of sources of lead causing contamination problems in single outlets. The testing protocol to be used by public water suppliers (i.e., under the Lead and Copper Rule or National Primary Drinking Water Regulation for lead) is designed to identify system-wide problems.

The testing protocol described in this section has been field tested and found to provide results that are generally reliable. Despite the fact that lead levels of samples taken at various times from the same sample site may vary, the results will generally be similar.

Overview of the Two-Step Sampling Process

This section provides a brief definition and overview of the purpose of each of the two steps in EPA's lead testing protocol.

Step 1:
Initial Sampling



In Step 1, **initial screening samples** are taken to determine (1) the lead content of water entering your facility and (2) the lead content of water sitting in various outlets within your building. The goal of Step 1 is to **identify problem outlets** or outlets with high lead concentrations.

To determine the lead content in water entering your facility, contact your public water supplier to identify what lead levels your might expect. *(If you completed the plumbing profile questionnaire discussed previously, you will already have this information.)* Second, test water representative of your service connector to determine what contribution the connector is making to lead concentrations in your building. Obviously, if the water coming into your facility or through your service connector contains excessive amounts of lead, you are likely to see similar or even greater amounts of lead when you test individual drinking water outlets.

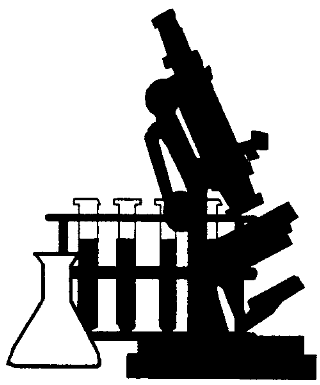
For individual outlets, initial samples generally involve the collection of **"morning, first-draw" water**. Such samples consist of the first "plug" of water emitted from an outlet after the outlet has been sitting for a period of 8 hours or more *(see general collection procedures on page 50)*. As you will recall, the longer water is in contact with plumbing containing lead, the more opportunity exists for the water to pick up lead. Morning, first-draw water most often contains the highest concentrations of lead. Such samples will, therefore, generally reflect the "worst case scenario" for a given outlet.

The Trigger to Follow-Up Testing

>20 ppb

If initial test results reveal lead concentrations greater than 20 ppb for a given outlet, follow-up testing is recommended. EPA has established this numeric cut-off, or trigger to follow-up testing to ensure that the sources of lead contamination in drinking water outlets are identified. The protocol, which consists of an established sample size volume and water retention time, is aimed at identifying lead problems in outlets under "worst case" conditions.[1]

Step 2: Follow-Up Sampling



In Step 2, **follow-up samples** are collected and analyzed from outlets whose initial test results revealed lead concentrations greater than 20 ppb. The purpose of Step 2 is to **pinpoint where lead is getting into drinking water** so that appropriate corrective measures can be taken. Additional samples from the interior plumbing within the building are often necessary to further pinpoint the sources of lead contamination.

As with initial samples, follow-up samples are to be taken <u>before</u> a facility opens and <u>before</u> any water is used *(see general collection procedures on page 50)*. Follow-up samples generally involve the collection of water from an outlet where the water has run for 30 seconds. This sampling approach is designed to analyze the lead content in the water in the plumbing behind the wall and the outlet. This is in contrast to the initial sample, which measures the lead content of the water in the outlet itself. A comparison of initial and follow-up samples will enable you to assess where the lead may be getting into the drinking water: either from the outlet or from the plumbing directly behind the outlet. Exhibit 9 provides diagrams of some common drinking water outlets and "cut-aways" of the plumbing behind these devices.

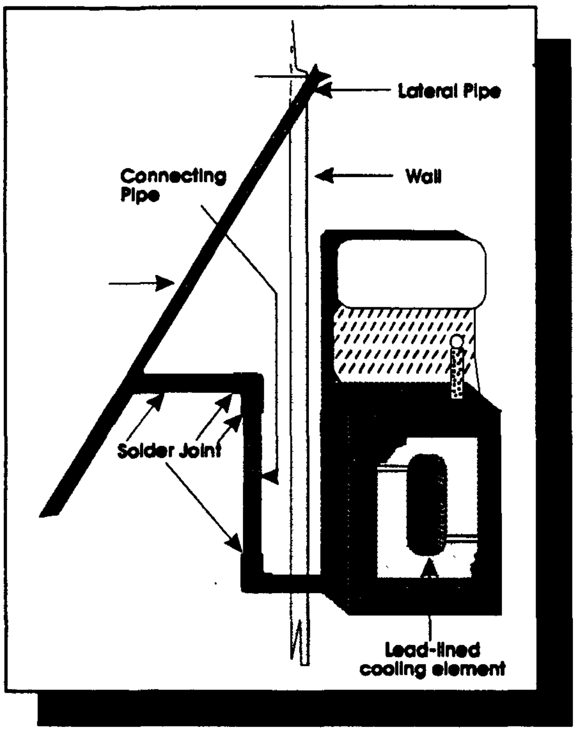
Depending upon the number of outlets to be tested, both initial and follow-up testing can be completed in one day, <u>or</u> initial samples can be taken first with follow-up testing conducted once initial test results are completed and interpreted.

The total number of samples to be taken from a building will depend upon the size of the building, the number of outlets used to supply drinking water, and the expected extent of contamination. More outlets with elevated lead levels will require correspondingly more follow-up samples to pinpoint the sources of contamination. **In general, a larger number of samples will result in the best assessment of the source and extent of lead in your drinking water.** *Part 2 of this document contains the general procedures to be followed in collecting samples and provides instructions for both initial and follow-up testing by outlet type.* The next section of this Part explores the remedies than can be employed if lead problems are found.

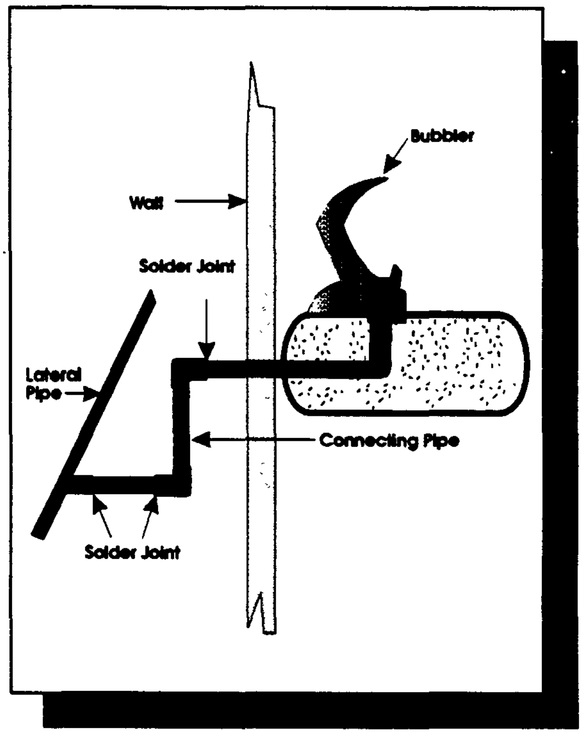
[1]Under the National Primary Drinking Water Regulation for lead, an action level of 15 ppb is established for samples taken by public water suppliers in high-risk residences. It is important to note that the testing protocol used by public water suppliers is aimed at identifying system-wide rather than individual outlet problems. Moreover, the sample size volume and water retention time are different. As a result, the action level is lower for public water suppliers than the level that is recommended under this testing protocol for schools and non-residential buildings.

When the lab returns your test results, the concentrations of lead in your drinking water samples will be reported in metric form such as milligrams per liter (mg/L) or micrograms per liter (µg/L), <u>or</u> they will be reported as a concentration such as parts per million (ppm) or parts per billion (ppb), respectively.

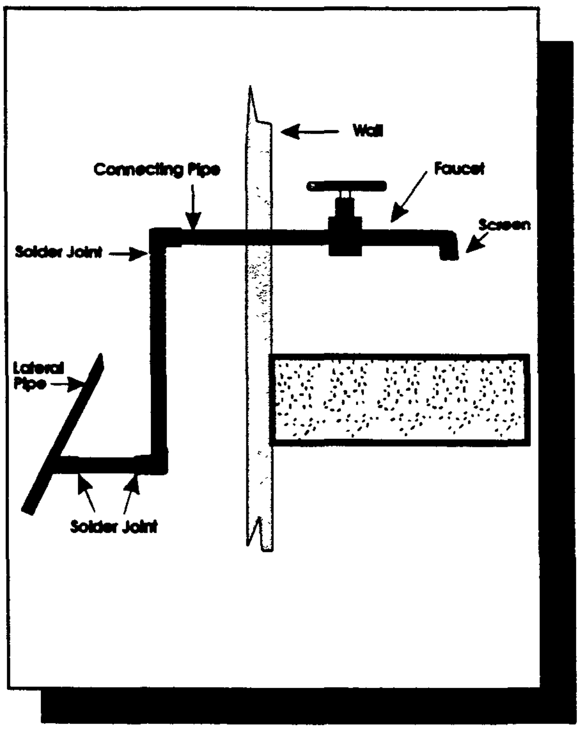
- **One milligram is 1/1,000 of a gram (about the size of a tiny pinch of salt); 1 mg/L is equal to 1 ppm.**
- **One microgram is one, one-millionth of a gram (one thousand times smaller than a milligram); 1 µg/L equals 1 ppb.**
- **0.005 mg/L or ppm is equal to 5 µg/L or ppb (note the movement of the decimal point).**



Water Cooler



Bubbler



Faucet (Tap)

Sources of Lead in Drinking Water

Common sources of lead in drinking water include;

- solder
- fluxes
- pipes and pipe fittings
- fixtures (e.g., brass faucets containing alloys of lead)
- sediments

Exhibit 9 Common Drinking Water Outlets

Section 4
Remedies

Solutions to lead problems typically need to be made on a short-term as well as permanent basis. For example, there are steps you can take while you wait for your test results or until a permanent solution has been put in place that will successfully reduce lead levels. These types of solutions are considered *interim* remedies. The solutions that are long-term in nature are considered *permanent* remedies.

There is no set method for selecting remedies. The decision to follow a particular approach must be based on the age/condition of your plumbing, the nature of your water supply, the results of testing, and the sources of lead contamination. In other words, the selection of remedies is highly site-specific and typically involves the conduct of additional follow-up sampling. It is important that you identify the sources of lead contamination through follow-up testing before employing permanent remedies. There have been instances where facilities proceeded to the remedy stage before conducting follow-up testing, only to later learn that their solution did not solve the lead contamination problem.

Outlined below are various routine, interim and permanent remedies. To aid you in the process of selecting remedies, three case studies have been included in Exhibits 11 through 13. The intent of these case studies is to provide you with a sense of the process involved in selecting a corrective measure and the role of follow-up testing in pinpointing lead problems.

Routine Control Measures

In addition to employing short-term and permanent remedies, a number of routine activities should be conducted to avoid possible exposures to lead:

- **Clean debris from all accessible screens frequently.** If you discovered sediments in faucet screens, have the sediments tested for lead and continue to clean your screens frequently. If your facility does not appear to have a sediment problem, you should still continue to periodically inspect your screens.
- **Use only cold water for food and beverage preparation in cafeterias and cooking classes.** Hot water will dissolve lead more quickly than cold water and is likely to contain increased lead levels. If hot water is needed, it should be taken from the cold water tap and heated on a stove or in a microwave oven. These procedures should be continued even if the lead levels in your building are found to be low as a result of testing.

Interim (or Short-Term) Control Measures

Until more permanent solutions bring lead levels down, you should implement interim measures to reduce lead contamination in your facility's drinking water. You might consider implementing interim control measures while you are waiting for your test results to return from the lab. You might also consider implementing short-term measures while you are waiting to see if more permanent solutions will work. **Before discontinuing any interim measure, you should be certain (as a result of testing) that the lead levels of your drinking water do not exceed 20 ppb.** Some examples of interim control measures include:

- **"Flush" the piping system in your building.** Do not use water that has been in contact with your building's plumbing for more than 6 hours, such as overnight or after weekends and vacations. "Flushing" involves opening all suspect taps every morning before the facility opens and letting the water run for a period of time to clear water standing in the interior pipes and/or the outlets. The flushing time varies by the type of outlet being cleared. The degree to which flushing helps reduce lead levels can also vary depending upon the age and condition of the plumbing and the corrosiveness of the water. Below is a discussion of the advantages and disadvantages of flushing. Review this information before deciding whether flushing is appropriate as a short-term remedy in your facility. Flushing instructions by outlet type are presented in Exhibit 10.

Exhibit 10 Flushing Directions by Outlet Type

Remember that each drinking water outlet must be flushed individually; flushing a toilet will not flush your water fountains. All flushing should be recorded in a log submitted daily to the office in charge of this program.

(1) To flush the **interior plumbing**, locate the faucet furthest away from the service line on each wing and floor of the building, open the faucets wide, and let the water run for 10 minutes. For best results, calculate the volume of the plumbing and the flow rate at the tap and adjust the flushing time accordingly. This 10-minute time frame is considered adequate for most buildings. However, if you are concerned that this flushing time is inadequate because of the size of your building, the diameter of your pipes, and/or the intricacy of your piping system, you may wish to consult a local plumber or engineer. The plumber or engineer could calculate a more exact flushing time period based on such factors as length and diameter of pipe and volume and flow rate of water at the faucet (i.e., the faucet furthest away from the service line).

(2) Open valves at all **drinking water fountains without refrigeration units** and let the water run for roughly 30 seconds to one minute.

(3) Let the water run on all **refrigerated water fountains** for 15 minutes. Because of the long time period required, routinely flushing refrigerated fountains may not be feasible. It may therefore be necessary to replace these outlets with lead-free drinking devices.

(4) Open all kitchen faucets (and other faucets where water will be used for drinking and/or cooking) and let the water run for 30 seconds.

Advantages:

- Quickest and easiest solution to high lead levels, especially when contamination is localized in a small area or in a small building.
- Does not require installation or maintenance of water treatment equipment.
- Does not require complex instructions.

Disadvantages:

- The most obvious disadvantage to flushing is the potential waste of water involved in the flushing procedures. If water supplies are limited in your area, some alternatives to daily flushing include:
  - Flush pipes only after weekends or vacations when lead levels may be highest (use only if lead levels do not exceed 20 ppb on a daily basis).
  - Thoroughly flush several designated drinking water outlets daily while taking all others temporarily out of service.
  - Use bottled water.
  - Collect water being flushed and use for non-consumptive purposes.
- Another obvious disadvantage to flushing is the amount of time and staff needed to perform the task:
  - If the water is very corrosive or if the plumbing is new, flushing may need to be done more than once a day, since lead levels in the water can return to high levels very quickly. To determine the number of additional flushes required, take additional follow-up samples at the end of the business day. Depending upon your test results, you may need to flush the system twice daily — once in the morning before the facility opens and a second time before a lunch period. **If lead levels return to their original levels within 4 hours of flushing, flushing is not a practical solution.**

- If contamination is widespread in a large building, flushing will take a lot of time and can waste water.

- Supervisors will have to check on the personnel performing the flushing to ensure that instructions are followed correctly and that accurate records are maintained and reviewed. Taking occasional follow-up samples from the outlets is one method of checking.

- Routine daily flushing of water coolers is not feasible because they take such a long time to flush.

- **Provide bottled water.** This can be an expensive alternative but might be warranted if you expect or are aware of widespread contamination and flushing is not an option. If you use bottled water, be aware that it is not regulated by EPA but rather by the Food and Drug Administration (FDA). The FDA typically adopts standards for bottled water similar to those standards established by EPA for public water systems. In January 1993, the FDA published a proposal in the *Federal Register* (at 58 FR 389) to lower the maximum allowable lead concentration in bottled water from 50 ppb to 5 ppb. The final regulation, which is expected to include the 5 ppb standard, is due to be published in May 1994. *This value should not be confused with EPA's action levels of 15 ppb for public water suppliers and 20 ppb for schools and non-residential buildings. These last values are associated with testing protocols and are aimed at identifying lead contamination problems.*

Your State may also regulate bottled water, and, in some instances, these standards may be more stringent than the Federal requirements. **EPA recommends that you require a written statement from the bottled water distributor guaranteeing that the bottled water meets FDA and State standards.**

Permanent Remedies

You can take a number of actions to permanently reduce or eliminate the sources of lead that originate in your building's plumbing. Some of these actions may allow the elimination or reduction of routine flushing or other interim measures. After obtaining an understanding of your water supply and the lead conditions in your facility (as a result of testing), you need to examine the permanent treatment options and select those most appropriate to your situation. Obviously, your decision will be based on such factors as cost, likelihood of success, availability of water, and staffing requirements.

- **Water that is soft or acidic can be treated by the public water supplier to make it less corrosive.** The 1986 Safe Drinking Water Act generally requires that public water systems undertake actions to make their waters non-corrosive if the results of a tap sampling program reveal elevated lead levels. As recommended earlier, contact your public water supplier to learn what it is doing to minimize corrosion throughout the system. If your water supplier just recently initiated corrosion control treatment, you might discuss the period of time before such treatment will have a possible effect on the lead in your facility. In the interim, however, you should implement routine and short-term remedies to reduce exposure to lead. Finally, follow-up testing should be conducted after corrosion control treatment begins before you rely on this solution on a permanent basis.

If lead levels remain high (above 20 ppb), then you should consider another type of remedy.

- **Corrosion control devices for individual buildings, such as calcite filters, soda ash or phosphate solution tanks, and feeder units are commercially available.** These types of devices treat the water for lead at the point where water enters the building (i.e., near the service connection). These devices are known as point-of-entry (POE) devices and are most suitable for facilities that provide their own water supply. POE devices typically cost $900 to $2,500, depending on the size of the building.

  Facilities that provide their own water supply are subject to the provisions of the 1986 Safe Drinking Water Act, which means that they must make their water non-corrosive to minimize lead at the tap. A

POE device is one possible corrosion control measure such a facility could implement. **Note**: Facilities that do not own their own water supply and are considering a POE device as a permanent remedy should consult the State drinking water program for guidance *(see Appendix A for a listing of State programs)*. In some states, the installation of such a device might define the facility as a "public water system" and, therefore, make the facility subject to all applicable laws.

You should consider a number of factors when selecting a device for your facility, including the devices' records of performance to reduce corrosion. Typically, a manufacturer will recommend a practical maintenance program once a device is installed. A good maintenance and quality assurance program is important for ensuring that the device performs as it is intended.

Note: Carbon, sand, cartridge filters, and water softeners will not prevent corrosion.

- **Lead levels can be reduced at the tap.** Reverse osmosis and distillation units are commercially available and can be effective in removing lead. Since these devices also make the water corrosive, they should only be used when placed at the tap. Such placement means the devices only treat the water at the outlets where they are placed. Such devices are termed point-of-use (POU) devices. There are a number of POU cartridge filter units on the market that effectively remove lead.

  POU devices can be either purchased or leased. They can be fairly inexpensive ($65 to $280) or expensive (ranging from $250 to $500, and up to $2,100 for a computerized reverse osmosis treatment unit), their effectiveness varies, and they are vulnerable to vandalism. Like POE devices, they also require a maintenance contract for regular upkeep to ensure effectiveness. Cartridge filter units need to be replaced periodically to remain effective. NSF International, an independent, third-party certification organization, has a testing program to evaluate the performance of POU devices. Before purchasing any device, contact NSF International at 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, MI 48106.

- **Existing wires already grounded to the water pipes can possibly be removed by a qualified electrician, and an alternative grounding system be installed.** Electrical current accelerates the corrosion of lead in piping materials. If your local or State building codes allow, consider finding an alternative grounding system and have a qualified electrician make the change. Be aware that the removal of grounding from water pipes may create a shock hazard unless an acceptable, alternative ground is provided.

- **If the sources of lead contamination are localized and limited to a few outlets, replacing these outlets may be the most practical solution.** Note that some new brass fixtures, valves and fittings, even though they contain less than 8 percent lead under the "lead-free" requirements of the 1986 Safe Drinking Water Act, can leach sufficient amounts of lead in drinking water to warrant concern. In fact, these products may leach more lead than the old plumbing product because the water has not had time to build up a protective scale on the inside of the fixture.

  EPA is currently working with industry to develop a voluntary certification standard that will minimize lead leaching from brass plumbing products. In the meantime, you should request the distributor and/or manufacturer of any product you intend to purchase for the results of any lead testing studies. Refrain from purchasing any products from a manufacturer that is unwilling to provide you with lead testing information.

- **Lead pipes within the system and those portions of the lead service connectors under the water supplier's jurisdiction can be replaced.** Contact your public water supplier about this replacement. However, your facility may be responsible for replacing a portion of a lead service connector that is under its own administrative jurisdiction, rather than under the jurisdiction of the water supplier.

- **In some facilities, the plumbing system might be modified so that water supplied for drinking or cooking is redirected to bypass sources of lead contamination.** Before undertaking such an alternative, be certain of the sources of lead contamination. Follow-up testing would also be necessary, as with the other remedies, to ensure that the measure results in reduced lead levels at the tap.

- **Flushing individual problem outlets or all outlets may also represent a solution.** There are advantages and disadvantages to flushing. Flushing is often the quickest and easiest solution to high lead levels, especially when contamination is localized in a small area or in a small building. *See the Short-term Remedies section above for a discussion of the advantages/disadvantages of this remedy in addition to outlet flushing instructions. Review this information before deciding whether flushing is appropriate as a permanent remedy in your facility.*

- **Time-operated solenoid valves can be installed and set to automatically flush the main pipes (headers) of the system.** It is important to note that solenoid valves are not practical for flushing water coolers. These would need to be flushed manually by staff. *See Short-term Remedies section above for flushing instructions for water fountains.*

- **If other treatment fails or is impractical, bottled water can be purchased for consumption by the building community.** As noted under the short-term remedies section above, make sure that the bottled water you select meets Federal and/or State standards for lead and other drinking water contaminants. EPA recommends that you require a written statement from the bottled water distributor guaranteeing that the lead levels in the water do not exceed 5 ppb.

- **Make sure that any plumber who does repair or replacement work on the facility's plumbing system uses only "lead-free" solders and other materials.** The 1986 Safe Drinking Water Act requires that only "lead-free" materials be used in new plumbing and plumbing repairs. Make sure all plumbers and other workers adhere to these requirements. These actions will ensure that new lead is not introduced into the facility's plumbing system. Report any violations of the "lead-free" requirements to your local plumbing inspector or the State drinking water program *(see Appendix A for a directory of State programs).*

Case Studies

The following three case studies are based on real-life experiences and are intended to illustrate the types of remedial actions that can be employed to eliminate/reduce lead at drinking water outlets. The first two case studies involve facilities that own or operate their own water supply and are, therefore, subject to the requirements of the Safe Drinking Water Act. The remaining case study involves a facility that purchases its water from a public water system. For such facilities, it is important that the water supplier be contacted to obtain information regarding the quality of the water being distributed. The remedies discussed in the following case studies include:

- Removal of outlets from service, replacement of outlets with lead-free devices, system flushing, and follow-up sampling (Case Study 1).

- Pipe and outlet replacement, testing of the source water, and installation of point-of-entry treatment and corrosion control (Case Study 2).

- Flushing, plumbing replacement, meter replacement, and POU treatment (Case Study 3).

These case studies demonstrate that follow-up testing is critical to a successful lead abatement program. They also illustrate the importance of planning sample collection efforts and profiling the plumbing system. System profiling includes such activities as inspecting all outlets to determine their make and model and documenting the types, age, and location of piping and plumbing fixtures. A lead sampling program, consisting of initial and follow-up testing, involves pinpointing sources of lead problems (thereby eliminating other sources from consideration) and, in turn, identifying appropriate remediation measures.

Exhibit 11 Case Study 1

Case Study 1

This case study illustrates how officials of one public school system, which owns and operates its water supply, solved a lead problem. This example presents the school system's approach to determining the sources of lead and selecting corrective measures. The remedies employed included replacement of problem outlets with lead-free devices, flushing of outlets, and follow-up sampling.

Study to Determine Lead Sources and Levels

The public school system, together with the county health department, conducted a study to measure potential lead contamination at drinking water outlets in 33 buildings. The study was conducted in two phases.

Develop Profile of the System

In Phase I of the study, a questionnaire was developed and used to generate a profile of each school's plumbing system. All outlets used for drinking water and/or food preparation were identified by (1) type of outlet (i.e., tap, bubbler, cooler or ice machine), (2) manufacturer of outlet device, (3) model number of outlet device, and (4) serial number of outlet.

Conduct Testing

In Phase II of the study, outlets identified in Phase I were sampled for water lead content. The results of lead testing revealed that 15 percent of the outlets had lead levels above 50 parts per billion (ppb) and that 25 percent of the outlets had lead levels between 20 and 49 ppb. Follow-up tests revealed no apparent lead problems in the internal plumbing systems of the 33 schools. Samples taken of the source water were also found to contain no lead. Moreover, the water supply was known to not be corrosive. *Although this case study was based on a facility that conducted testing prior to the finalization of EPA's Lead and Copper Rule for public water systems, the school system would have ultimately been required to minimize lead throughout its system under EPA's Lead and Copper Rule.*

Issue Public Notice

At the conclusion of the study, the school system issued a public notice in the form of a memorandum to all staff, parents, and students in the affected schools. The public notice consisted of the results of the Phase I survey and the Phase II test results, a statement ensuring that there was no immediate health threat, information concerning the steps the school system was taking to reduce water lead content, and an explanation of how test results could be obtained and reviewed. The school system did not experience any problems or negative consequences with members of the school community as a result of the lead public notice.

Determine and Install Remedies

Having conducted the survey and testing described above, the school system initiated immediate actions to reduce or eliminate water lead content. These actions included the following:

Outlet Replacement

All drinking water outlets tested that exceeded a level of 50 ppb lead were immediately taken out of service (by blocking or posting signs) and were replaced with lead-free outlets. Replacements consisted of (1) water coolers without lead parts or lead-lined tanks and (2) lead-free taps or valves at sink locations.

Flushing

All drinking water outlets tested with lead levels between 20 and 49 ppb were flushed for a minimum of 30 seconds daily (i.e., early in the morning) prior to usage. Water coolers with test results in this range were replaced with lead-free devices, since it was determined that it would be impractical to flush water coolers for lead (i.e., they require a 15-minute flushing period).

Additional Follow-up Sampling

Additional follow-up sampling was conducted to ensure that lead levels had been reduced at all outlets where remedies had been employed (including flushing). Test results revealed that lead levels, following outlet replacement and daily flushing, fell well below 20 ppb, EPA's level of concern in buildings.

Lessons Learned

- Planning sampling efforts is useful (i.e., developing a profile of the location and type and manufacturer of each outlet and developing a plan of action based on the plumbing profile). These activities enable sampling to be approached on a systematic basis and, in the long run, save time and money.
- Conducting public notification activities early can be valuable. Early notification saves the public from becoming panicked needlessly.
- Outlet replacement and flushing can serve as effective lead remedies.
- Follow-up testing should be conducted to ensure that remedies installed are actually successful in removing lead.

Exhibit 12 Case Study 2

Case Study 2

This case study discusses how the owners of a four-story office building with its own water supply pursued lead testing and corrected lead problems. The remedies employed included replacement of suspect piping and outlets, installation of a filtration point-of-entry unit, and corrosion control. This study illustrates why it is important to investigate the water supply as a potential source of contamination before implementing corrective measures.

Study to Determine Lead Sources and Levels

Building owners decided to test for lead contamination because they suspected lead materials in the building's plumbing system and they were concerned about the potential health effects of lead on users of the building.

Develop Profile of the System and Develop Sampling Plan

Prior to conducting testing, building officials conducted a plumbing profile. They learned that the building was initially constructed in 1941 and that portions of the building had been replumbed since this time with lead materials. Specifically, they learned that the piping from the well (the building's water supply) and all the header lines in the facility consisted of copper piping joined by lead solder.

Based on the results of the plumbing profile, building officials designed a sampling program that involved testing all outlets used for drinking. Initial test results revealed lead levels between 24 and 996 ppb.

Determine and Install Remedies

Having conducted the initial testing, building officials initiated immediate actions to reduce or eliminate water lead content in the facility. These actions included the following:

Pipe and Outlet Replacement

Because of the age of the piping and the known use of lead solder, building officials decided to replace all existing piping with plastic piping as well as replace all existing fixtures with lead-free devices (i.e., 2 water coolers, 2 bubbler heads, and 4 kitchen taps). Building officials suspected all of these sources to be the cause of lead contamination.

Follow-up Testing

After the piping and fixtures had been replaced, follow-up testing was performed only to reveal that lead levels in the water had not been reduced. Results of follow-up tests were between 24 and 996 ppb (the same as for initial testing). These results prompted building officials to reexamine their original strategy for lead abatement and to consider additional follow-up testing.

Source Water Testing

Building officials then tested water at the wellhead to determine whether the source water contained lead. *Note: It would have been more appropriate for this step to have been performed during initial testing to rule out source water as a potential contamination source. This might have saved time and money spent by building officials on new pipes, outlets, and fixtures.*

The results of source water testing, however, did not reveal any apparent lead problems. Yet, additional water quality tests (i.e., pH, alkalinity, hardness, etc.) did reveal that the water was very corrosive and, thus, likely to leach lead. It was then suspected that, although the fixtures had been replaced with lead-free devices, some leaching was still occurring in replacement fixtures. In general, the replacement fixtures were constructed of brass and legally contained alloys of less than 8 percent lead. The corrosiveness of the water and the newness of the fixtures containing lead were considered to be contributing to the excess lead levels still being witnessed.

Installation of Point-of-Entry Filtration Unit at Sediment Tank

Since the wellhead did not appear to be contributing lead, the next closest point to the wellhead, a water storage pressure tank, was then tested. Upon examination of the inside of the tank, it was discovered that a layer of sediment had formed on the bottom of the tank. Testing of the sediment revealed lead levels in excess of 3,000 ppb.

As a result, building officials cleaned the tank and installed a point-of-entry treatment device (i.e., a two-stage filtration system) to prevent lead and sediments from entering the water supplied to the building. Building officials also decided to routinely inspect and remove any sediment in the water tank. Follow-up testing at outlets throughout the building revealed average lead concentrations of 27 ppb. While the point-of-entry filtration system significantly reduced lead levels in the building, the average lead concentration was still higher than EPA's recommended 20 ppb level. This finding was evaluated, and building officials decided that it was probably due to the corrosiveness of the water and the lead in the new fixtures.

Installation of Treatment System

Building officials then decided to change their water treatment practices to reduce the corrosivity of the water and hopefully to reduce lead at the outlets. Consulting engineers were hired to aid in selecting the water treatment practices. After minimizing the corrosiveness of the water, follow-up testing showed the average concentration of lead at various outlets to be 11 ppb, well below EPA's 20 ppb level. *This case study was based on a facility that conducted a lead sampling program prior to finalization of EPA's Lead and Copper Rule for public water systems. Had building officials not conducted a lead sampling program, the Lead and Copper Rule would have ultimately required testing and treatment of the corrosive water supply.*

Lessons Learned

- Profiling the plumbing system and developing a thorough sampling plan (i.e., a plan that embodies testing of outlets, internal plumbing, and source water) are crucial to conducting a lead abatement program in a time- and cost-efficient manner.
- Eliminating the possibility that the source water is contributing to high lead levels during initial testing can save time and money (i.e., do not automatically replace pipes and fixtures without testing the source water first, and be certain that internal plumbing is contributing to lead before you replace piping).
- Brass fixtures can be a source of lead even though they legally contain less than 8 percent lead as called for in the lead-free requirements section of the Safe Drinking Water Act. If fixture replacement is called for, ensure that any new device purchased will leach the least amount of lead. Request the results of lead leaching tests from manufacturers and/or distributors.
- Reducing/eliminating lead in drinking water can involve a step-by-step, trial and error process. However, development of a plumbing profile and sampling plan and the conduct of both initial and follow-up testing should help in reducing the potential for remedies to be installed that ultimately do not resolve lead contamination problems. The key is to identify problems first before employing remedies. Follow-up testing after remedies are in place is also important to ensure success.

Exhibit 13 Case Study 3

Case Study 3

This case study illustrates how officials of one public school selected remedies after identifying lead problems. This study further illustrates how determining remedies can be a step-by-step process.

Determine Lead Sources and Levels

Initial testing by the local health department revealed high levels of lead at some of the school's drinking water outlets. As a result, school officials initiated a program to isolate and correct sources of lead problems.

Rule Out Source Water

Since the school purchases its drinking water from a public water system, the first step involved contacting the water supplier to determine the corrosivity and lead content of the source water. In addition, school officials asked the water supplier to determine whether lead materials were used in the service main and/or the service connector. Other water quality issues were also investigated.

The public water supplier indicated to school officials that the pH level of the water supply was between 8 and 9, which meant that the water was not highly corrosive. Recent lead testing by the supplier also revealed the source water to contain between 0 and 5 ppb of lead, levels below EPA's at-the-tap requirements for public water systems. School officials were also informed that the materials in the service main and the service connector were constructed of cast iron and would not likely contribute lead to the water.

Profile the System

Once school officials ruled out the water supply as a source of lead in their drinking water, they began a program of testing and visual inspection on the inside of the building to track down lead sources. First, the internal plumbing was inspected to determine what materials had been used during construction. The main part of the school, which had been built in the 1920s, appeared to consist mainly of galvanized steel pipes. Additions to the building in the 1970s appeared to consist mostly of copper pipes joined by lead solders. Each of these materials has the potential to cause elevated lead levels in drinking water.

Conduct Sampling

School officials then began a testing program in all parts of the building to identify outlets with lead problems. Test results indicated that 47 percent of the outlets in the oldest part of the building (1920s section) and over 80 percent of the outlets in the newer area (1970s section) had lead levels above 20 ppb. These test results indicated a widespread contamination problem. Both the school's interior plumbing and the outlets themselves could be considered possible contributors of lead.

Determine and Install Remedies

Because the contamination appeared to be widespread, school officials determined that simple solutions, such as merely taking outlets out of service or replacing fixtures, were not feasible. However, school officials realized that some type of overall solution needed to be implemented. Because of a limited budget, school officials evaluated several options.

Flushing

School officials first evaluated the effectiveness of flushing as a means to reduce lead levels at outlets. Flushing is one of the interim solutions that is recommended to alleviate lead problems until permanent solutions can be implemented. This proved to be an ineffective solution for the school because, after preliminary trials and testing, it was determined that the outlets would have to be flushed far too frequently to be feasible (i.e., more than once per day).

Plumbing Replacement

Next, school officials considered the cost-effectiveness of replacing the entire plumbing system to eliminate the sources of contamination completely (internal plumbing and outlets). However, because the contamination was widespread and because most of the plumbing was relatively inaccessible, replacement of the plumbing materials would have been too costly. School officials abandoned this possible remedy.

Meter Replacement

School officials then decided to replace a portion of the meter, which contained a bronze chamber and which was thought to contribute lead, with a plastic chamber. They thought this action might reduce lead entering the building and thereby reduce lead at the outlets. This remedy was employed, however, without prior testing being conducted on the service connection. Follow-up tests at outlets still revealed high lead levels even after this remedy was in place.

Point-of-Use (POU) Treatment

Officials then decided to perform an evaluation of the effectiveness of POU treatment devices at problem outlets to minimize lead. School officials selected POU filter devices that had been listed by NSF International and that were certified to remove lead.

After installing the POU filter devices at problem outlets, the facility collected follow-up samples. Follow-up first-draw and 30-second flushed samples revealed lead levels to have fallen well below EPA's 20 ppb concern level. The average concentration at any outlet was 8 ppb.

Lessons Learned

- When a facility purchases water from a water supplier, the supplier should be queried about the quality of the water (e.g., lead levels, corrosivity, types of pipes). This information can aid facility officials in developing a sampling plan and in determining whether lead contamination may be widespread or localized.
- Developing a plumbing profile further aids facility officials in determining whether lead problems may be widespread or localized.
- Many remedial actions are available, and careful consideration of all options is prudent before implementation. Initial and follow-up testing should be conducted to pinpoint sources of lead before remedies are installed. Moreover, service connection samples should be collected prior to selection of remedies. Follow-up testing should also be conducted once remedies are in place to ensure that the remedies are successful in reducing lead concentrations.

Section 5
Public Education

In addition to testing for lead and solving any contamination problems, a lead control program should also include a public education component. This section discusses the mandatory public notice requirements for reporting lead test results under the Lead Contamination Control Act (LCCA) and discusses the importance of developing an overall communication strategy. Finally, helpful communication hints are provided along with sample public notice materials.

Mandatory Public Notice Requirements Under the LCCA

Schools conducting a lead-in-drinking-water sampling program *must* comply with the public availability requirements of the Lead Contamination Control Act. There are two separate public availability requirements with which schools must comply:

(1) You must make available—in your administrative offices—a copy of the sampling results "for inspection by the public, including teachers, other school personnel, and parents."

(2) You must also notify relevant parent, teacher, and employee organizations of the availability of your sampling program results.

Given the health effects of lead, EPA advocates that any facility conducting sampling for lead make public any test results. In addition, such facilities should identify activities they are pursuing to correct any lead problems found.

> *Special Note:* Facilities regulated as public water systems must comply with significant additional regulatory, reporting, and public notice requirements as stipulated by the Safe Drinking Water Act and EPA's National Primary Drinking Water Regulation for Lead. Facilities that provide public drinking water should already be aware of their public notice responsibilities with respect to lead. Consult your State drinking water program with any questions *(see Appendix A).*

There are five basic public notification methods that—used alone or in various combinations—can be applied to communicate lead-in-drinking-water issues/problems and the meaning and significance of your sampling program results. These methods are not new, but are commonly employed by businesses and schools.

Choose the method that best suits your particular situation and/or protocol. Remember, you should not provide sampling program results to the public without also providing a basis for interpreting and understanding the significance of those results. This will create certain confusion and make your communication efforts much more difficult than necessary.

Press Release: A press release in the local newspaper can potentially inform a broad range of the local public of lead-in-drinking-water issues and the results of your sampling program. It is important that the release inform readers of how to obtain the sampling results and other lead-in-drinking-water information and perhaps even include the phone number of an informed and available facility official.

Follow-up Letters/Fliers: Letters or fliers represent the most direct and effective method of communicating lead-in-drinking-water activities to parents/guardians and other members of your school or building community. The letters and fliers should be mailed directly using any existing address lists.

Mailbox or Paycheck Stuffers: Mailbox and paycheck stuffers represent the most direct and effective method of communicating lead-in-drinking-water activities to employees such as teachers and business personnel. Stuffers would contain much the same information as that contained in a press release or letter/flier.

Staff Newsletter: A notice contained in a staff newsletter is a further option for directly and effectively communicating information about the lead program to employees.

Presentations: Providing lead sampling program briefings and presentations at facility-related meetings is yet another effective means of communication. Relevant events for schools include meetings of parent-teacher organizations, faculty, and the school board. Staff meetings might represent one option for presenting lead testing program information to members of a non-residential building.

The Components of an Effective General Communication Strategy

Lead in drinking water can be an emotional and sensitive issue, especially for parents who are concerned about their children's safety. As a result, you should not view communication and outreach activities as stand-alone or final efforts, but rather as a part of an *overall* or *general* communication strategy.

The purpose of a general communication strategy is to provide the means for addressing questions from members of your facility's community and also to provide ongoing, up-to-date information regarding your sampling efforts. *Ideally, you should designate a single spokesperson or special task force to interact with the public since it is important that your message remain consistent.*

The issues to be addressed as part of a communication strategy include:

- Participants
- Timing for delivery
- Contents of the message
- Methods and manner of communication.

Participants

Overall, there are four primary players or interests involved in the control of lead in drinking water:

States and EPA Regions: Both State drinking water programs and EPA Regional offices are responsible for ensuring that public water systems comply with the National Primary Drinking Water Regulation for lead and any additional or more stringent State standards. States are also responsible for assisting schools in implementing lead-in-drinking-water control programs.

Drinking Water Community: Public water systems comprise the regulated drinking water community, and they are responsible for complying with all national and State drinking water standards for lead. This means that they must ensure that the water they deliver is non-corrosive, contains minimal amounts of lead, and will not result in significant lead-leaching from plumbing in individual homes and buildings.

Local Community: The local community consists of those users of the facility who would be most affected by lead-in-drinking-water problems (i.e., business professionals, students, parents, school boards, teachers, and other employees). Members of the local community should be the primary targets of any general communication activities.

Larger Community: The local and regional media can serve as a conduit for information reaching a larger local community. It is important that you be prepared to generate accurate news releases. Also, your spokesperson or task force should be prepared to respond to interview requests with accurate and consistent information.

Timing

The timing of your communication activities is very important. Whenever public health risks are involved, public communication efforts are less complicated and generate less conflict if those potentially affected are notified in advance of important issues and events. At a minimum, you should provide information to members of the building community and the larger community (if deemed necessary) at the following three times.

- Before your lead-in-drinking-water sampling program begins.
- In response to periodic interest and/or pressure.
- After you obtain the results of testing and/or decide upon corrective measures.

Contents

Your communication messages should consist of the following information:

- Details about the nature of your drinking water lead control program.
- The results of your sampling program and your plans for correcting any identified problems.
- Information on the public health effects and risks posed by lead in drinking water and the significance of lead in drinking water versus other sources such as food and air.
- The availability of general lead-in-drinking-water information resources and the availability of the detailed sampling results for your facility.

Methods

The communication methods that can be used for your general communication strategy are largely the same as those described earlier in regard to mandatory notification methods and, thus, need not differ from communication activities common to school or non-residential building operations (i.e., meeting presentations, press releases, mailbox/paycheck stuffers, and letters to staff and parents).

Additional methods unique to your lead control program may include:

- Creating an information center located at a convenient place in the facility such as a library or break room.
- Creating a task force with representatives from the building community.
- Making available a list of laboratories that are State-certified to test home water for lead and other contaminants.
- (For schools) encouraging classroom science activities that focus on drinking water quality. *(Contact EPA's Safe Drinking Water Hotline—see Appendix D—for information on organizations that have such science activities).*

Helpful Hints for Communication

The following list contains some hints for effective communication:

- Take the initiative in providing information to your community (it is important to do so before the media does it for you). When public health risks are involved, especially with respect to children, vague or incorrect information can be worse than no information at all.
- Be a good and reliable source of information. That is, provide honest, accurate, and comprehensive information in every necessary area.
- Always speak with one voice (i.e., designate points of contact—preferably one person—to respond to parents and the media).
- Anticipate likely questions from members of the building community (e.g., employees, parents, teachers, students, members of civic organizations, media representatives). Each member of the community is likely to have a different concern and/or viewpoint on the subject of lead testing.
- Be positive, proactive, and forthcoming when working with the media. If you work together in a cordial manner, your communication efforts are likely to be less complex.
- Keep members of the building community up-to-date as important events and information on your lead testing program unfold.

Sample Public Notice Materials

Exhibit 14 contains a sample public notification letter that could be used and adapted to communicate lead testing information. Exhibit 15 is a sample press release for local media that could also be used or adapted.

Exhibit 14 Sample Public Notice Letter

Spring 1994

Anytown School Department
Anytown, USA 00000-0000

Dear Members of the Anytown School Community:

The United States Environmental Protection Agency (EPA) has determined that lead in drinking water is a health concern at certain levels of exposure. The groups most vulnerable to lead include fetuses and young children. Lead in pregnant women can damage a child before it is born, by lowering birth weight and slowing down normal physical and mental development. Lead in young children, especially those under the age of six, can result in lower IQ levels, impaired hearing, reduced attention span, and poor classroom performance. At high levels, lead can seriously damage the brain.

As a result of these health effects, EPA has applied more stringent regulations to public water systems. However, since lead is generally contributed to water via plumbing in individual homes and businesses, EPA has also advocated testing of water in private buildings. EPA recommends that action be taken if lead levels exceed 20 parts per billion (ppb) at any outlet tested.

In October 1988, the U.S. Congress passed the Lead Contamination Control Act, which specifically addressed the problem of lead in school drinking water. Following instructions given in an EPA guidance document especially designed for schools, we completed a plumbing profile for each of the buildings within the Anytown School District. Through this effort, we identified and tested those drinking water outlets most likely to have high levels of lead. Of the ___ samples taken, all but ___ tested well below EPA's recommended level of 20 ppb for lead.

The first contaminated outlet was a drinking water fountain (bubbler) at Kennedy High School. After follow-up testing was conducted, it was determined that the faucet (bubbler head) was the source of the lead contamination. The faucet was replaced with a lead-free faucet and retested. Follow-up test results revealed lead levels well below EPA's recommended level.

The second outlet, in the Lincoln Elementary School, was a faucet in the kitchen and showed unacceptable lead levels in both initial and follow-up testing. We found the source of the lead contamination to be the pipe providing water to the faucet. This pipe was replaced with lead-free materials.

A copy of the test results is available in our central office for inspection by the public, including teachers, other school personnel, and parents and can be viewed between the hours of 8:30 a.m. and 4:00 p.m. For more information about water quality in our schools, contact John Doe at the Anytown School Department, 555-2223. For information about water quality in your home or for questions about testing, contact Jane Smith at the Anytown Water Department, 555-1217.

Sincerely,

Fred Frank
Superintendent of Schools

Exhibit 15 Sample Press Release for Local Media

Anytown School Department
One School Street
Anytown, USA 00000-0000
Contact: Fred Frank, Superintendent

FOR IMMEDIATE RELEASE

News Release

Lead Levels in School Drinking Water Meet Federal Guidelines

Anytown, USA, April xx, 1994... The Anytown School Department announced today that recent tests of drinking water in the town's schools indicate that lead levels meet Federal guidelines. Although the testing program detected lead at two drinking water outlets at one elementary and one senior high school, lead levels were reduced following replacement of these outlets.

In making the announcement, School Superintendent Fred Frank stated, "We are pleased that the testing program has verified that lead is not a problem in our school drinking water."

The School Department conducted the testing program to make sure that drinking water in the school system is safe for children and school staff. Water with high lead levels can contribute to negative health effects, especially in young children.

The testing was conducted in January by school personnel following Federal and State guidelines. Samples from various locations in each of the schools were sent to a State-certified laboratory for analysis. The laboratory results were received by the School Department last week.

Information about the lead testing program, including the laboratory results, can be found at the School Department office at the above address, weekdays between 8:30 a.m. and 4:30 p.m.

STOP

Part 2
Lead Testing Protocol

Section 1
General Procedures

This section outlines the general procedures involved in collecting drinking water samples for lead testing. Specifically, the section discusses laboratory analysis and collection, and handling procedures.

Laboratory Analysis and Handling of Sample Containers

(1) As discussed in the previous section, the certified drinking water lab you select to conduct your analyses will provide sample collectors, or they will provide you with materials and instructions if you plan to collect your own samples. Do not attempt to prepare your own sample containers unless you have qualified personnel and an appropriate facility. Sample containers should be prepared in a clean laboratory environment by qualified laboratory personnel using the appropriate purity chemicals.

If you collect your own samples, follow the instructions provided by the lab for handling sample containers to ensure accurate results. Do not rinse the sample containers before filling. The lab has prepared the containers to receive the samples you will take, and the containers may contain a chemical needed to preserve the samples properly until the samples reach the laboratory. Avoid any contact with this chemical. Be careful not to overfill the sampling containers with water. *For more information about the preparation of sample containers and sample preservation, refer to Appendix F. This information should also be shared with the laboratory officials with whom you plan to work.*

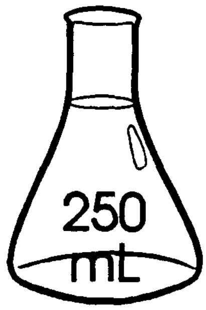
Collection Procedures

(2) Collect all water samples before the facility opens and before any water is used. Ideally, the water should sit in the pipes unused for at least 8 hours but not more than 18 hours before a sample is taken. This time distinction is made to ensure that the water collected is representative of the building's normal water use patterns. At some infrequently used outlets, time gaps may routinely be 18 hours. In such situations, the sample will be representative of the building's normal water consumption pattern for that particular outlet.

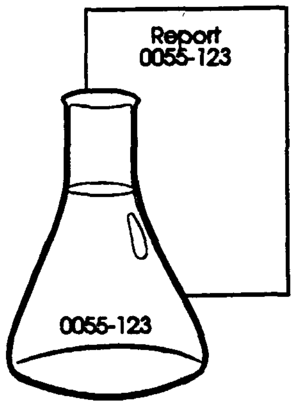
(3) Make sure that no water is withdrawn from the taps or fountains from which the samples are to be collected prior to their sampling. Samples collected from the designated sites after the taps have been used will indicate lower lead levels. It is important that consistent procedures be used in taking samples so that generalizations about test results can be made.

(4) Unless specifically directed to do so, do not collect samples in the morning after vacations, weekends, or holidays. If lead is a problem in your facility, these samples will contain higher lead levels than those collected at other times. Such samples would not be representative of the normal water use patterns within your facility.

(5) All water samples collected should be 250 milliliters (ml) in volume. Make sure the sample containers you plan to use will accommodate this volume of water and are appropriately marked.



(6) Assign a unique sample ID number to each sample collected that is reflective of the type of outlet and outlet location being tested. Record this ID number on the sample bottle and on your recordkeeping form. On your recordkeeping form, also denote such information as the type of sample taken, the date and time of collection, name of the sample collector, the location of the sample site, name of the manufacturer that produced the outlet, and the outlet's model number. *Consult the sample form in Appendix E for additional recordkeeping items.*



Response Actions

(7) Institute interim and permanent corrective measures in your facility, as necessary, to minimize exposure to lead contamination. *See discussion of this topic in Part 1, Section 4 of this document for details.*

Section 2 Initial and Follow-Up Sampling by Outlet Type

The protocol for collecting initial and follow-up samples is generally the same for various drinking water outlets, with the exceptions of service connectors, ice makers, and water coolers. The initial and follow-up testing protocol, as well as the interpretation of test results, is described in Exhibits 16 through 22 for the following types of outlets:

- **Service connections**
- **Drinking water fountains** *(four types)*
    - **Bubblers or drinking water fountains (without central chillers):** water is supplied to the bubbler or fountain directly from the building's plumbing.
    - **Bubblers or drinking water fountains (with central chillers):** a central chiller unit cools water for a number of drinking water fountains or bubblers in the building.
    - **Water coolers:** devices are equipped with their own cooling and storage systems; water is supplied to the device from the building's plumbing.
    - **Bottled water dispensers:** type of water fountain whose water is supplied from bottled water.
- **Ice making machines**
- **Water faucets.**

Please note that sampling ID codes have been indicated in the descriptions of the sampling protocol for each outlet type, and they are denoted on the plumbing diagrams that follow in Exhibits 25 and 26 *(see pages 80 and 81)*. These sampling ID codes have been included for illustrative purposes only. When you conduct testing in your facility, you will assign unique numbers for every sample you collect (*see discussion under the general requirements section above*).

Following the instructions for collecting initial and follow-up samples and for interpreting test results are instructions for conducting sampling of the interior plumbing of buildings (Exhibit 23). Instructions are included for sampling lateral loops and headers, and riser pipes. These types of samples are necessary if follow-up outlet samples show lead levels above 20 ppb.

Finally, Exhibit 28 gives an overview of the sampling process presented in this guidance manual.

> *EPA's lead testing protocol for schools and non-residential buildings emphasizes that first-draw or initial samples should be taken from all drinking water outlets. Follow-up samples should then be collected at only those outlets where initial test results revealed lead levels greater than 20 ppb.*

Exhibit 16 Service Connection Sampling

Service Connection Sampling

Until recently, lead pipes up to 2 1/2 inches in diameter were used for service connectors in some locations. Other materials used for service connectors include copper, galvanized steel, plastic, and iron. Lead service connectors can produce significant lead levels in your drinking water.

To test water in your service connector, locate the tap **closest to the service connector.** This is especially important for larger facilities where more than one service connection is present.

Sample Collection Procedures:

- **Sample 1S (Service Connection)**

  Take this sample before the facility opens. Open the tap closest to the service connection. Let the water run, and feel the temperature of the water. As soon as you feel the water change from warm to cold, collect the sample. Because water warms slightly after standing in the interior plumbing, this colder water represents the water that has been standing just outside of the building and in contact with the service connector.

- **Sample 1M (Water Main)**

  This sample is representative of the water that has been standing in the distribution main. It will help pinpoint whether the service connector is the source of any lead. Take the sample from the same location as sample 1S. Let the water run, and feel the temperature of the water. When you feel the water change from warm to cold, allow the water to run an additional 3 minutes and then collect the sample.

Interpreting Test Results:

- **If the lead level of Sample 1S (service connector) significantly exceeds 5 ppb (for example, 10 ppb) and is higher than in sample 1M**, lead is contributed from the service connector. Check for the presence of a lead service connector by scratching it with a knife or key. Lead is soft and dull gray in appearance. When scratched, it will be shiny. In the absence of a lead service connector, lead goosenecks or other materials containing lead in line with the service connection may be the source of the contamination. Usually, no significant amount of lead (above 5 ppb) comes from the distribution main (i.e., water from the public water supplier or private water source).

- **If the lead level of Sample 1M (water main) significantly exceeds 5 ppb (for example, 10 ppb),** lead in the water may be attributed to the source water, sediments in the main, or to lead in the distribution system such as from lead joints used in the installation or repair of cast iron pipes. If the water supplied is from a well, lead may also be getting into the water if the materials of construction of the well pump contain lead alloys.

- **If the lead level of Samples 1S and 1M are very low (close to 5 ppb),** very little lead is being picked up from the service line or the distribution main. If any of your other initial screening samples indicate a problem with lead contamination, the source of that contamination is the interior plumbing and/or outlets themselves (or sediments containing lead that are trapped in the plumbing or on screens). The problem is not the water supply or the service connection.

Examples:

- Sample 1S (20 ppb) exceeds Sample 1M (5 ppb) = 15 ppb of lead is contributed from the service connector; the lead amount in the main (Sample 1M) does not exceed 5 ppb; therefore, you may want to check for a lead service connector or gooseneck depending upon results of lead testing at other outlets in the building; if you reduce lead at the connection, lead levels may be reduced throughout the remainder of the building.

- Sample 1M is 10 ppb and Sample 1S is 10 ppb = very little lead is contributed from the service line; source of lead is most likely the water main.

- Sample 1S (7 ppb) and Sample 1M (6 ppb) are close to 5 ppb = very little lead (1 ppb) is being picked up in the water from the service line or the distribution main; very little lead is contributed from the source water; if other outlets show significantly higher lead levels, the source of the contamination is the interior plumbing and/or the outlets themselves.

  For sample locations, see Exhibit 25: Plumbing Diagram for a Single-Level Building and Exhibit 26: Plumbing Diagram for a Multilevel Building.

Exhibit 17 Drinking Water Fountains: Bubblers Without Central Chiller

Drinking Water Fountains: Bubblers Without Central Chiller

Do not close the shut-off valves to the water fountains to prevent their use. Minute amounts of scrapings from the valves will produce inaccurate results showing higher than actual lead levels in the water. Take all samples with the taps fully open.

Sample Collection Procedures:

- **Initial Screening Sample 1A**

This sample is representative of the water that may be consumed at the beginning of the day or after infrequent use. It consists of water that has been in contact with the bubbler valve and fittings and the section of plumbing closest to the outlet of the unit.

Take this sample before the facility opens and before any water is used. Collect the water immediately after opening the valve without allowing any water to run into the drain. Take follow-up samples from those bubblers where test results indicate lead levels over 20 ppb.

- **Follow-Up Sample 2A**

This sample is representative of the water that is in the plumbing upstream from the bubbler (from the bubbler back toward the service connector and the water main). Take this sample before the facility opens and before any water is used. Let the water from the fountain run for 30 seconds before collecting the sample.

Interpreting Test Results:

To determine the source of lead in the water, compare the test results of Samples 1A and 2A.

- **If the lead level in Sample 1A is higher than that in Sample 2A,** a portion of lead in the drinking water is contributed from the bubbler.
- **If the lead level in Sample 2A is very low (close to 5 ppb),** very little lead is picked up from the plumbing upstream from the outlet. The majority or all of the lead in the water is contributed from the bubbler.

- **If the lead level in Sample 2A significantly exceeds 5 ppb (for example, 10 ppb),** lead in the drinking water is also contributed from the plumbing upstream from the bubbler.

- **If the lead level in Sample 2A exceeds 20 ppb,** EPA recommends sampling from the header or loop supplying water to the lateral to locate the source of the contamination. *(Sampling instructions for interior plumbing can be found in Exhibit 23.)*

Example 1:

- Sample 1A (31 ppb) exceeds Sample 2A (7 ppb) = 24 ppb of lead is contributed from the bubbler.

- Sample 2A (7 ppb) does not significantly exceed 5 ppb = very little lead (2 ppb) is being picked up from the plumbing upstream from the bubbler; the majority of the lead in the water is contributed from the bubbler.

- Sample 2A (7 ppb) does not exceed 20 ppb = sampling from header or loop supplying water to the lateral is not necessary.

- **Possible Solution:** Replace fixture, valves, or fittings on bubbler with lead-free device (request results of lead leaching tests from distributors or manufacturers of any fixtures you intend to purchase); retest water for lead after new materials installed.

Example 2:

- Sample 1A (31 ppb) exceeds Sample 2A (25 ppb) = 6 ppb of lead is contributed from the bubbler.

- Sample 2A (25 ppb) significantly exceeds 5 ppb = about 20 ppb of lead is being contributed from the plumbing upstream from the bubbler.

- Sample 2A (25 ppb) exceeds 20 ppb = sampling header or loop supplying water to the lateral is necessary to locate the source of the contamination *(consult Exhibit 23 for sampling instructions for interior plumbing—Samples 1H and 1I).*

- **Possible Solution:** Depending upon the results of testing of the header or loop supplying water to the lateral, possible solutions could consist of replacing the bubbler fixture, valves, or fittings with lead-free materials or replacing upstream piping, piping joints, or both. Other alternatives might consist of removing the bubbler from service and providing water in another lead-free area of the building, providing bottled water, or flushing the outlet and/or interior plumbing on a daily basis; retest water for lead after any remedy is employed.

For sample locations, see Exhibit 25: Plumbing Diagram for a Single-Level Building and Exhibit 26: Plumbing Diagram for a Multilevel Building.

Exhibit 18 Drinking Water Fountains: Bubblers With Central Chiller

Drinking Water Fountains: Bubblers With Central Chiller

Do not close the valves to the water fountains to prevent their use. Minute amounts of scrapings from the valves will produce inaccurate results showing higher than actual lead levels in the water. Take all samples with the taps fully open.

Sample Collection Procedures:

- **Initial Screening Sample 1B**

  This sample is representative of the water that is consumed at the beginning of the day or after infrequent use. It consists of water that has been in contact with the bubbler valve, the fittings, and the section of the plumbing closest to the outlet of the unit.

  Take this sample before the facility opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to run into the drain. Take follow-up samples from those water fountains where test results indicate lead levels over 20 ppb.

- **Follow-Up Sample 2B**

  This sample is representative of the water that is in the plumbing upstream from the bubbler. Take this sample before the facility opens and before any water is used. Let the water from the fountain run for 30 seconds before collecting the sample.

Interpreting Test Results:

To determine the source of lead in the water, compare the test results of Samples 1B and 2B.

- **If the lead level in Sample 1B is higher than that in Sample 2B,** a portion of lead in the drinking water is contributed from the bubbler.

- **If the lead level in Sample 2B is very low (close to 5 ppb),** very little lead is picked up from the plumbing upstream from the outlet. The majority or all of the lead in the water is contributed from the bubbler.

- **If the lead level in Sample 2B significantly exceeds 5 ppb (for example, 10 ppb),** lead in the drinking water is also contributed from the plumbing upstream from the bubbler.

- **If the lead level in Sample 2B exceeds 20 ppb,** EPA recommends sampling from the chiller unit supplying water to the lateral to locate the source of the contamination. (See Sample Collection Procedures and Interpretation of Test Results for Central Chiller Unit below.)

Example 1:

- Sample 1B (25 ppb) exceeds Sample 2B (3 ppb) = 22 ppb of lead is contributed from the bubbler.

- Sample 2B (3 ppb) is close to 5 ppb = very little lead (2 ppb) is being picked up from the plumbing upstream from the bubbler; the majority or all of the lead is contributed from the bubbler.

- **Possible Solution:** Replace bubbler valve, fittings and/or fixture with lead-free materials (request results of lead leaching studies from manufacturers of brass products before purchasing to ensure that harmful amounts of lead will not be leached); retest water once new materials installed.

Example 2:

- Sample 1B (38 ppb) exceeds Sample 2B (21 ppb) = 17 ppb of lead is contributed from the bubbler.

- Sample 2B (21 ppb) significantly exceeds 5 ppb = about 21 ppb of lead is being contributed from the plumbing upstream from the bubbler.

- Sample 2B (21 ppb) exceeds 20 ppb = sampling from the chiller unit supplying the water to the lateral is necessary to locate the source of the contamination *(see instructions and examples below for sampling chiller units).*

For sample locations, see Exhibit 27: Water Supply to Water Fountains and Bubblers from Central Chiller.

Sample Collection Procedures—Central Chiller Unit:

- **Follow-Up Sample 3B**

  This sample is representative of water that has been in contact with the plumbing supplying water to the chiller. Take this sample before the facility opens and before any water is used. Take the sample from a tap or valve as close to the inlet of the chiller as possible. Collect the water immediately after opening the tap or valve, without allowing any water to waste.

- **Follow-Up Sample 4B**

  This water sample consists of water that has been in contact with the chiller unit and the plumbing upstream which supplies water to the chiller. Often, water supplied to the bubblers is recirculated to the chiller unit. In this instance, Sample 4B consists of a mixture of water from the water supply and recirculated water from the plumbing supplying water to the bubblers.

  Take the sample from a tap or valve as close to the outlet of the chiller as possible. Collect the water immediately after opening the tap or valve, without allowing any water to waste.

Interpreting Test Results—Central Chiller Unit:

- **If the lead level in Sample 2B is higher than that in Sample 4B,** lead is contributed from the plumbing supplying the water from the chiller to the bubbler.

- **If the lead level in Sample 4B is higher than in Sample 3B,** a portion of the lead may be coming from the chiller. Note: Sludge and sediments containing high levels of lead may accumulate in chiller tanks. If the test results indicate that lead is contributed from the chiller unit, check for the presence of debris and sludge. Remove any of these materials from the chiller, flush the chiller unit, and resample the water.

- **If the lead level in Sample 3B exceeds 20 ppb,** EPA recommends additional sampling from the distribution system supplying water to the chiller to locate the source of contamination. *(Refer to Exhibit 23 on Sampling Interior Plumbing for testing information.)*

- **If the lead level in Sample 3B is very low (close to 5 ppb),** very little lead is picked up from the plumbing upstream from the chiller. The majority or all of the lead in the water may be attributed to the chiller and the plumbing downstream from the chiller.

Example 1:

- Sample 2B (21 ppb) exceeds Sample 3B (10 ppb) = 11 ppb of lead is contributed from the plumbing supplying the water from the chiller to the bubbler.
- Sample 3B (10 ppb) exceeds Sample 4B (4 ppb) = a portion of the lead (6 ppb) may be coming from the chiller; check for and remove any debris and sludge in the chiller unit; flush the unit, and resample the water.
- Sample 4B (4 ppb) does not exceed 20 ppb = additional sampling from the distribution system supplying water to the chiller is not necessary.
- Sample 4B (4 ppb) is very close to 5 ppb = very little lead is picked up from the plumbing upstream from the chiller; the majority or all of the lead in the water can be attributed to the chiller and the plumbing downstream from the chiller.
- **Possible Solutions:** Flush the chiller unit and plumbing; if lead levels are still high, replace plumbing supplying water from the chiller to the bubbler; replace the bubbler fixture, fittings, and valves with lead-free materials; and/or clean sludge and debris from chiller unit. Retest water for lead once changes have been made.

Example 2:

- Sample 2B (45 ppb) exceeds Sample 4B (28 ppb) = 17 ppb of lead is being contributed from the plumbing supplying water from the chiller to the bubbler.

- Sample 4B (28 ppb) exceeds Sample 3B (21 ppb) = 7 ppb of lead is contributed by the chiller.

- Sample 3B (21 ppb) exceeds 20 ppb = additional sampling from the distribution system supplying water to the chiller is necessary to locate the source of the contamination *(see Exhibit 23 on Sampling Interior Plumbing for instructions).*

- **Possible Solution:** Flush the chiller unit and plumbing; retest the water. Depending upon the results of testing of the distribution system supplying water to the chiller, possible solutions include replacing upstream plumbing; replacing bubbler fixtures, valves, or fittings with lead-free materials; and flushing the chiller unit outlet and interior plumbing. Retest water for lead after changes have been made.

For sample locations, see Exhibit 27: Water Supply to Water Fountains and Bubblers from Central Chiller.

Exhibit 19 Drinking Water Fountains: Water Coolers

Drinking Water Fountains: Water Coolers

Do not close the valves to the water fountains to prevent their use. Minute amounts of scrapings from the valves will produce inaccurate results showing higher than actual lead levels in the water. Take all samples with the taps fully open.

Sample Collection Procedures:

Two types of water coolers are used: the wall-mounted and the free-standing types. Water in these coolers is stored in a pipe coil or in a reservoir. Refrigerant coils in contact with either of these storage units cools the water. Sources of lead in the water may be the internal components of the cooler, including a lead-lined storage unit; the section of the pipe connecting the cooler to the lateral pipe; and/or the interior plumbing of the building.

Prior to testing, check the make and model numbers of your water coolers and compare them to EPA's listing of coolers that have lead parts or lead-lined tanks *(see Appendix C for a summary of the water cooler issues and EPA's list of affected coolers).* If you have a Halsey Taylor cooler that is on EPA's list of coolers with lead-lined tanks, consult Halsey Taylor for information on their replacement/refund program and associated testing directions. Contact information is provided in Appendix C.

Regardless of whether your water cooler appears on EPA's listing, initial testing should be conducted.

- **Initial Screening Sample 1C**

  This sample is representative of the water that may be consumed at the beginning of the day or after infrequent use. (Although in some areas of infrequent use, the water may not have been used in more than 18 hours, the sample is still representative of the normal water consumption pattern.) The sample consists of water that has been in contact with the interior plumbing, the valve and fittings, the storage unit, and the section of plumbing closest to the outlet of the unit.

  Take this sample before the facility opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to waste. Take follow-up samples from those water coolers whose test results indicate lead levels greater than 20 ppb.

In conducting follow-up testing with water coolers be aware of the following:

- Some water coolers manufactured before 1988 may have storage tanks lined with materials containing lead. You should contact the manufacturer of any water cooler units you have purchased or are planning to purchase for written guarantees that no lead has been used in the unit. *A list of brands and model numbers of coolers that contain lead has been prepared by EPA and is summarized in Appendix C.*

- Sediments and debris containing lead on screens or in the plumbing frequently produce significant lead levels *(see Follow-Up Sample 4C)*.

- Lead solder in the plumbing can also contribute to the problem.

- **Follow-Up Sample 2C**

  This water sample is representative of the water that is in contact with the plumbing upstream of the cooler. Take this sample **after the facility closes**. Let the water from the fountain run for 15 minutes before collecting the sample. **You must flush the cooler for 15 minutes to ensure that no stagnant water is left in the storage unit.**

- **Follow-Up Sample 3C**

  Take this sample **before the facility opens** and before any water is used. **This sample must be taken the morning after you collect Follow-Up Sample 2C.** Collect the water immediately after opening the faucet without allowing any water to waste.

  Because the water in the cooler was flushed the previous afternoon, this sample is representative of the water that was in contact with the cooler overnight, not in extended contact with the plumbing upstream. As such, it may differ from Initial Screening Sample 1C.

Interpreting Test Results:

- **If the lead level in Sample 3C is higher than that in Sample 2C,** the water cooler may be contributing lead to the water.

- **If the lead level in Sample 3C is higher than that in Sample 2C AND the lead level in Sample 1C is higher than that in Sample 3C,** the plumbing upstream from the water cooler may also be contributing lead to the water.

- **If the lead level in Sample 3C is identical or close to that of Sample 2C,** the water cooler probably is not contributing lead to the water.

- **If the lead level in Sample 1C is higher than that in Sample 3C AND if the lead levels in Sample 2C and 3C are similar,** the plumbing upstream from the cooler or the plumbing connection leading to the cooler, or both, is contributing lead to the water.

- **If the lead level in Sample 2C is in excess of 10 ppb and is equal to or greater than the lead levels in Samples 1C and 3C,** the source of the lead may be sediments contained in the cooler storage tank, screens, or the plumbing upstream from the cooler.

Sample Collection Procedures—Additional Water Cooler Testing

- To verify the source of lead, take the following steps:

  (1) Take a 30-second flushed sample from a tap upstream from the cooler or compare Sample 2C results with the results obtained from follow-up samples taken from outlets upstream from the cooler. If low lead levels are found in these samples (close to 5 ppb), the source of lead may be sediments in the cooler or the plumbing connecting the cooler to the lateral or lead solder in the plumbing between the taps.

  (2) If the flushed samples from the upstream outlets have lead levels in excess of 5 ppb, then the cooler and the upstream plumbing may both contribute lead to water.

- To confirm whether the cooler is the source of lead, take **Follow-Up Sample 4C.**

  Turn off the valve leading to the cooler. Disconnect the cooler from the plumbing and look for a screen at the **inlet**. Remove the screen. If there is debris present, check for the presence of lead solder by sending a sample of the debris to the laboratory for analysis.

  Some coolers also have a screen installed at their **outlet**. Carefully remove the bubbler outlet by unscrewing it. Check for a screen and debris and have a sample of any debris analyzed.

  Some coolers are equipped with a drain valve at the **bottom of the water reservoir.** Water from the bottom of the water reservoir should be sampled and any debris analyzed.

Collect Sample 4C from the disconnected plumbing outlet in the same manner as you collected Sample 1C. Compare the results from Sample 4C to the other sample results.

Interpreting Additional Water Cooler Test Results:

- **If the lead level in Sample 4C is less than 5 ppb,** then lead is coming from the debris in the cooler or the screen.
- **If the lead level in Sample 4C is significantly higher than 5 ppb,** the source of lead is the plumbing upstream from the cooler.

Example 1:

- Sample 1C (54 ppb) = the plumbing upstream from the cooler and/or the water cooler is contributing lead.
- Sample 3C (40 ppb) exceeds Sample 2C (5 ppb) = the water cooler is contributing 35 ppb of lead.
- Sample 3C (40 ppb) exceeds Sample 2C (5 ppb) **and** Sample 1C (54 ppb) exceeds Sample 3C (40 ppb) = the plumbing upstream from the cooler is contributing 14 ppb of lead.
- Sample 2C (5 ppb) is less than 10 ppb and Sample 2C is less than Sample 1C (54 ppb) and Sample 3C (40 ppb) = the source of lead is not sediments contained in the cooler storage tank, screens, or plumbing upstream from the cooler.
- **Possible Solutions:** Replace the cooler with one that contains lead-free components, and retest the water or find an alternative lead-free drinking water source; locate source of lead from plumbing and eliminate it *(routine flushing is not applicable as a potential remedy for water coolers—see discussion of this issue in Section 4 of Part 1 of this guidance document for further information).*

Example 2:

- Sample 3C (42 ppb) exceeds Sample 2C (41 ppb) **and** Sample 1C (44 ppb) exceeds Sample 3C (42 ppb) = the plumbing upstream from the cooler is contributing 2 ppb of lead to the water.

- Sample 3C (42 ppb) is close to Sample 2C (41 ppb) = the water cooler probably is not contributing lead to the water.

- Sample 1C (44 ppb) exceeds Sample 3C (42 ppb) **and** Sample 3C and Sample 2C (41 ppb) are close = the plumbing upstream from the cooler or the plumbing connection to the cooler, or both, is contributing lead to the water.

- Sample 2C (41 ppb) exceeds 10 ppb **and** Sample 2C is less than Sample 1C (44 ppb) and Sample 3C (42 ppb) = source of lead is not likely sediments contained in the cooler storage tank or screens.

- Sample 4C (43 ppb) significantly exceeds 5 ppb = the source of lead is the plumbing upstream from the cooler.

- **Possible Solutions:** Move the cooler to an area in the building where plumbing is free of lead, and retest the water; replace the plumbing upstream from the cooler with lead-free materials, and retest the water; or provide an alternative lead-free water source such as bottled water *(flushing is not applicable as a potential remedy for water coolers—see discussion of this issue in Section 4 of Part 1 of this guidance document for further information).*

For sample locations, see Exhibit 25: Plumbing Diagram for a Single-Level Building and Exhibit 26: Plumbing Diagram for a Multilevel Building.

Exhibit 20 Drinking Water Fountains: Bottled Water Dispensers

Drinking Water Fountains: Bottled Water Dispensers

Sample Collection Procedures:

- **Initial Screening Sample 1D**

  This sample is representative of the water that may be consumed at the beginning of the day or after infrequent use. It consists of water that has been in contact with the dispenser valve and fittings incorporated in the outlet of the unit.

  Take this sample before the facility opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to waste. Take follow-up samples from those bottled water dispensers where test results indicate lead levels over 20 ppb.

- **Follow-Up Sample 2D**

  Collect this sample directly from the bottle that supplies the water to the unit. This will enable you to determine the source of lead in the water.

Interpreting Test Results:

- **If the lead level in Sample 1D is higher than that in Sample 2D,** lead may be coming from the dispenser unit.
- **If the lead level in Sample 2D is identical or close to that in Sample 1D,** the source of lead is the bottled water.

Note: Public water systems must ensure that water delivered to customers is minimally corrosive to avoid lead being added to the water as a result of customer plumbing. The FDA, which regulates the interstate sale of bottled water, has proposed a 5 ppb standard for lead in bottled water. This standard is expected to go final in May 1994. EPA recommends that you contact your distributor for written assurance that the bottled water does not exceed Federal and State bottled water standards.

Example 1:

- Sample 1D (23 ppb) exceeds Sample 2D (5 ppb) = 18 ppb of lead is contributed from the dispenser unit.
- **Possible Solution:** Replace dispenser unit with one that is made of lead-free materials and retest.

Example 2:

- Sample 1D (24 ppb) and Sample 2D (23 ppb) are close = the source of lead is the bottled water.
- **Possible Solutions:** Purchase another type of bottled water for which the distributor provides written assurance that lead levels do not exceed Federal and State lead standards, or find other alternative lead-free water source. Retest after any remedy has been employed.

Exhibit 21 Ice Making Machines

Ice Making Machines

Sample Collection Procedures:

- **Initial Screening Sample 1E**

  Fill a suitable container (250 mL or larger, wide-mouthed bottle or Whirlpak TM) prepared by the laboratory at least three-quarters full of ice. Do not touch the ice with your hands. Use the non-metal scoop or disposable plastic gloves provided by the lab.

  If the lead level in Sample 1E exceeds 20 ppb, collect a follow-up sample to determine if the source of the lead is the plumbing or the ice making machine itself.

- **Follow-Up Sample 2E**

  Disconnect the ice maker from the plumbing and look for a screen at the inlet. Remove the screen. If debris is present, forward a sample of the debris to the laboratory for analysis. The laboratory will determine whether lead solder is present. If the debris contains lead, the screen should be cleaned routinely.

  Collect the sample from the disconnected plumbing as close to the ice maker as possible. Fill the sample container with 250 mL of water.

Interpreting Test Results:

- **If the lead level in Sample 2E is close to 5 ppb,** the source of the lead in the ice is the ice maker.

- **If the lead level in Sample 2E significantly exceeds 5 ppb (for example, 10 ppb),** lead is also contributed from the plumbing upstream from the ice maker.

- **If the lead level in Sample 2E exceeds 20 ppb,** EPA recommends sampling from the distribution system supplying water to the ice maker. *Refer to Exhibit 23 on Sampling Interior Plumbing for instructions.*

Example 1:

- Sample 1E is 22 ppb and Sample 2E (6 ppb) is close to 5 ppb = source of the lead (16 ppb) is the ice maker.

- **Possible Solutions:** Replace plumbing components in ice maker with lead-free materials; clean debris from plumbing and screen at inlet to ice maker; replace with lead-free ice maker; retest after any remedy has been employed.

Example 2:

- Sample 1E = 22 ppb and Sample 2E (21 ppb) significantly exceeds 5 ppb = lead is contributed from the plumbing upstream from the ice maker.

- Sample 2E (21 ppb) exceeds 20 ppb = sampling from the distribution system supplying water to the ice maker is recommended *(see Exhibit 23 for instructions).*

Exhibit 22 Water Faucets (Taps)

Water Faucets (Taps)

Sample Collection Procedures:

- **Initial Screening Sample 1F**

  This sample is representative of the water that may be consumed at the beginning of the day or after infrequent use. It consists of water that has been in contact with the fixture and the plumbing connecting the faucet to the lateral pipes.

  Take this sample before the facility opens and before any water is used. Collect the water immediately after opening the faucet without allowing any water to go to waste. Follow-up samples should be taken from those water faucets where test results indicate lead levels over 20 ppb.

- **Follow-Up Sample 2F**

  This sample is representative of the water that is in the plumbing system upstream from the faucet. Take this sample before school opens and before any water is used. Let the water from the faucet run for 30 seconds before collecting the sample.

Interpreting Test Results:

- **If the lead level in Sample 1F is higher than that in Sample 2F,** the source of lead is the water faucet and/or the plumbing upstream from the faucet.

- **If the lead level in Sample 2F is very low, close to 5 ppb,** very little lead is coming from the plumbing upstream from the faucet. The majority or all of the lead in the water is from the faucet and/or the plumbing connecting the faucet to the lateral.

- **If the lead level in Sample 2F significantly exceeds 5 ppb (for example, 10 ppb),** lead may be contributed from the plumbing upstream from the faucet.

Example 1:

- Sample 1F (39 ppb) exceeds Sample 2F (6 ppb) = 33 ppb of lead is contributed from the water faucet.
- Sample 2F (6 ppb) is close to 5 ppb = very little lead is coming from the plumbing upstream from the faucet; the majority of the lead is coming from the faucet and/or the plumbing connecting the faucet to the lateral.
- **Possible Solutions:** Replace faucet with lead-free device (request copies of lead leaching studies from manufacturers of brass faucets and fixtures before purchasing); replace plumbing connecting the faucet to the lateral with lead-free materials; flush outlet and connecting plumbing each day; apply point-of-use device designed to remove lead; find alternative water source such as bottled water or other lead-free location in the building; retest after any remedies are employed.

Example 2:

- Sample 1F (49 ppb) exceeds Sample 2F (25 ppb) = source of lead (24 ppb) is the water faucet and the plumbing upstream from the outlet (25 ppb).
- Sample 2F (25 ppb) significantly exceeds 5 ppb = lead may be contributed from upstream from the faucet; evaluate lead test results conducted upstream from the faucet to ascertain potential contributions of lead from the upstream piping. To pinpoint location test interior plumbing *(see instructions for sampling interior plumbing in Exhibit 23).*
- **Possible Solutions:** Replace faucet with lead-free device (request copies of lead leaching studies from manufacturers of brass faucets and fixtures before purchasing); replace plumbing connecting faucet to the lateral with lead-free materials; replace suspected portion of interior plumbing with lead-free materials; flush the outlet and interior plumbing each day; apply point-of-use device designed to remove lead; find alternative water source such as bottled water or water from other lead-free location in the building; retest after any remedies are employed.

For sample locations, see Exhibit 25: Plumbing Diagram for a Single-Level Building and Exhibit 26: Plumbing Diagram for a Multilevel Building.

Exhibit 23 Sampling Interior Plumbing

Sampling Interior Plumbing

In general, if lead levels exceed 20 ppb in follow-up samples taken from drinking water outlets, additional samples from designated sample sites in the interior plumbing should be collected. Samples should be taken from laterals, loops and/or headers, and riser pipes. The configuration of interior plumbing will vary depending on the layout of a given building. *See Exhibits 25 and 26 for sample diagrams of the interior plumbing in single-level and multilevel buildings.*

Sampling should proceed systematically upstream from initial follow-up sample sites. The goal of this type of sampling effort is to isolate those sections of the interior plumbing that contribute lead to the water. This is achieved by comparing the results of interior plumbing samples with the results of previously collected outlet samples.

LATERALS

Laterals are the plumbing branches between a fixture or group of fixtures (e.g., taps and water fountains).

Sample Collection Procedures:

- **Sample 1G**

  Open the tap that has been designated as the sample site for the lateral pipe. Let the water run for 30 seconds before collecting the sample. Collect a 250 mL sample. The purpose of flushing the water is to clear the plumbing between the sample site and the lateral pipe. This action will ensure collection of a representative sample.

  Note: Sample 1G corresponds to follow-up samples taken from other outlets such as 2A, 2E and 2F. Compare the results of these samples from outlets upstream and downstream of Sample 1G for additional information on the source of the lead within the interior plumbing.

Interpreting Test Results:

- **If the lead level in Sample 1G exceeds 20 ppb,** collect additional samples from the plumbing upstream (i.e., from the service line, the riser pipe, the loop, or header supplying water to the lateral).

Note: High lead levels may also be caused by recent repairs and additions using lead solders or by sediments and debris in the pipe. Debris in the plumbing is most often found in areas of infrequent use, and a sample should be sent to the laboratory for analysis.

- **If the lead level of Sample 1G is the same as the lead level in a sample taken downstream from Sample Site 1G,** lead is contributed from the lateral or from interior plumbing upstream from the lateral. Possible sources of lead may be the loop, header, riser pipe, or service connection.

- **If the lead level in Sample 1G is very low,** close to 5 ppb, the portion of the lateral upstream from Sample Site 1G and the interior plumbing supplying water to the lateral are not contributing lead to the water.

- **If the lead level in Sample 1G significantly exceeds 5 ppb (for example, 10 ppb) and is less than the lead level in a sample taken downstream from Sample Site 1G,** a portion of the lead is contributed downstream from the sample site.

Example:

- Sample 1G (22 ppb) exceeds 20 ppb = collect additional samples from the plumbing upstream to further pinpoint the source of lead (i.e., from the service line, the riser pipe, the loop, or the header supplying water to the lateral); see instructions below for collecting these types of samples.

- Sample 1G (22 ppb) significantly exceeds 5 ppb and is less than downstream site (35 ppb) = a portion of the lead (13 ppb) is contributed downstream from the sample site.

- Sample 1G (22 ppb) is not similar to downstream site (35 ppb) but both exceed 20 ppb = lead is contributed from the lateral or from interior plumbing upstream from the lateral; possible sources of lead may be the loop, header, riser pipe, or service connection; further sampling is necessary.

- **Possible Solution:** Following the collection of additional samples from plumbing upstream to pinpoint sources of lead, replace plumbing with lead-free materials; retest water for lead.

For sample locations, see Exhibit 25: Plumbing Diagram for a Single-Level Building and Exhibit 26: Plumbing Diagram for a Multilevel Building.

LOOPS AND/OR HEADERS

A loop is a closed circuit of a plumbing branch that supplies water from the riser to a fixture or a group of fixtures. A header is the main pipe in the internal plumbing system of a building. The header supplies water to lateral pipes.

EPA recommends that water samples from each loop and/or header be collected because use patterns may vary among locations within a building. Construction materials may also vary among loops, especially in larger buildings where additions and repairs have been made to the original structure.

Sample Collection Procedures:

- **Sample 1H (header) or 1I (loop)**

  Locate the sampling point furthest from the service connection or riser pipe on the floor. Open the faucet and let it run for 30 seconds before collecting this sample. Fill the sample container with 250 mL of water. The purpose of flushing the water is to clear the faucet and plumbing between the sample site and the loop and/or header pipe, thus ensuring collection of a representative sample.

Interpreting Test Results:

- **If the lead level is over 20 ppb,** collect additional samples from the plumbing upstream supplying water to the loop or header. Compare the sample results with those taken from the service line or the riser pipe that supplies water to the loop and/or header.

  High lead levels may also be caused by recent repairs and additions using lead solders or by sediment and debris in the pipe. Debris in the plumbing is most often found in areas of infrequent use, and a sample should be sent to the lab for analysis. The laboratory will provide instructions on how to package and handle the sediment.

- **If the lead level of Sample 1H or 1I is equal to the lead level in a sample taken downstream from Sample Site 1H or 1I,** the lead is contributed from the head or the loop and from interior plumbing upstream from the header or loop. Possible sources of lead may be the loop, header, riser pipe, or service connection.

- **If the lead level in Sample 1H or 1I is close or equal to 5 ppb,** the portion of the header or loop upstream from Sample Site 1H or 1I and the interior plumbing supplying water to the header or loop are not contributing lead to the drinking water. The source of lead is downstream from the sample site.

- **If the lead level in Sample 1H or 1I significantly exceeds 5 ppb (for example, 10 ppb) and is less than the lead level in a sample taken downstream from Sample Site 1H or 1I,** a portion of the lead is contributed downstream of the sample site.

Example:

- Sample 1H or 1I (23 ppb) exceeds 20 ppb = collect additional samples from the plumbing upstream supplying water to the loop or header; compare the results with those taken from the service line or the riser pipe that supplies water to the loop and/or header.

- Sample 1H or 1I (23 ppb) significantly exceeds 5 ppb **and** Sample 1H or 1I is less than downstream site (25 ppb) = a small portion of the lead (2 ppb) is contributed downstream of the sample site.

- **Possible Solution:** Following the collection of additional samples upstream from the header or loop to pinpoint source of lead, replace affected plumbing with lead-free materials; retest water for lead.

For sample locations, see Exhibit 25: Plumbing Diagram for a Single-Level Building and Exhibit 26: Plumbing Diagram for a Multilevel Building.

RISER PIPES

A riser is the vertical pipe that carries water from one floor to another.

Sample Collection Procedures:

- **Sample 1J**

Open the tap closest to the riser pipe. Let the water run for 30 seconds before collecting the sample. Fill the sample container with 250 mL of water. The purpose of flushing the water is to clear the faucet and plumbing between the sample site and the riser pipe. This approach will ensure collection of a representative sample.

Interpreting Test Results:

- **If the lead level in Sample 1J exceeds 20 ppb,** collect additional samples from the plumbing upstream from the riser. High lead levels in the riser pipes may also be caused by recent repairs and additions using lead solder.

- **If the lead level of Sample 1J equals the lead level in a sample taken downstream from Sample Site 1J,** the source of the lead is the riser pipe or the plumbing and service connection upstream from the riser pipe.

- **If the lead level in Sample 1J is close or equal to 5 ppb,** the portion of the riser pipe and plumbing upstream from Sample Site 1J and the service connection are not contributing lead to the water. The source of the lead is downstream of the sample site.

- **If the lead level in Sample 1J significantly exceeds 5 ppb (for example, 10 ppb) and is less than the lead level in a sample taken downstream from Sample Site 1J,** a portion of the lead is contributed downstream from the sample site.

Example:

- Downstream Site is 25 ppb, Service Connection Sample is 4 ppb, and Sample 1J (6 ppb) is less than 20 ppb = additional samples from upstream need not be collected; 21 ppb of lead is contributed from the downstream site.

- Sample 1J (6 ppb) is not equal to downstream site (25 ppb) = source of lead is not the riser pipe or the plumbing and service connection upstream from the riser pipe.

- 1J (6 ppb) is close to 5 ppb = the portion of the riser pipe and plumbing upstream from Sample Site 1J and the service connection are not contributing lead to the water; the source of lead is downstream of the sample site.

- **Possible Solution:** Following the collection of samples from interior plumbing downstream from the riser pipe and the affected outlet to pinpoint the source of lead, replace affected plumbing with lead-free materials; retest water for lead.

  For sample locations, see Exhibit 25: Plumbing Diagram for a Single-Level Building and Exhibit 26: Plumbing Diagram for a Multilevel Building.

Exhibit 24 Summary of Samples

Summary of Samples

Initial Screening Samples	*Follow-Up Samples*	*Type of Outlet or Plumbing*
1S	1M	Service Connection to Distribution Main
1A	2A	Bubblers Without Central Chiller
1B	2B	Bubblers With Central Chiller
-	3B, 4B	Central Chiller Unit
1C	2C, 3C, 4C	Water Coolers
1D	2D	Bottled Water Dispensers
1E	2E	Ice Making Machines
	2F	Water Faucets (Taps)
		INTERIOR PLUMBING
-	1G	Laterals
-	1H	Headers
-	1I	Loops
-	1J	Risers

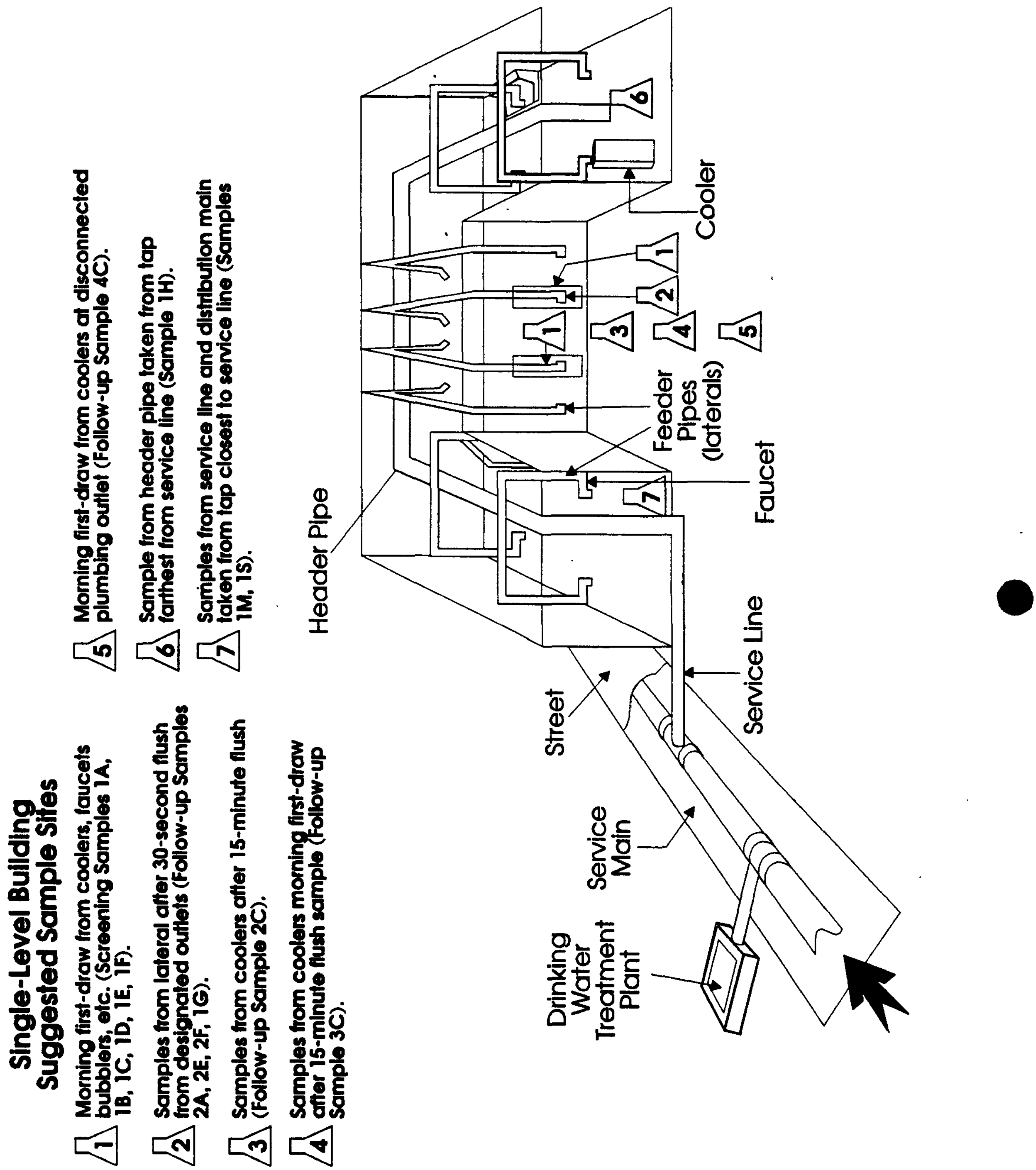


Exhibit 25 Plumbing Diagram for a Single-Level Building

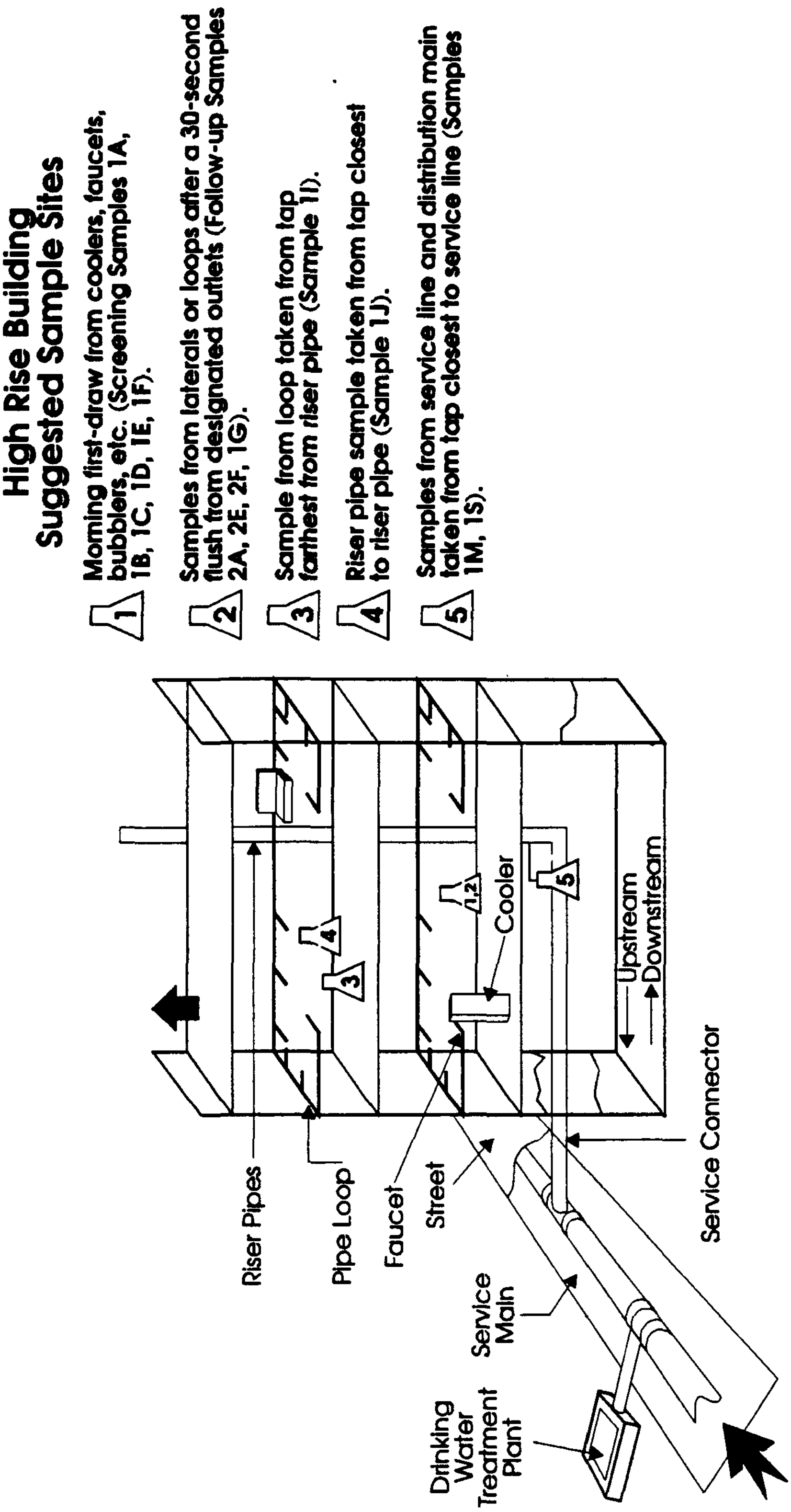


Exhibit 26 Plumbing Diagram for a Multilevel Building

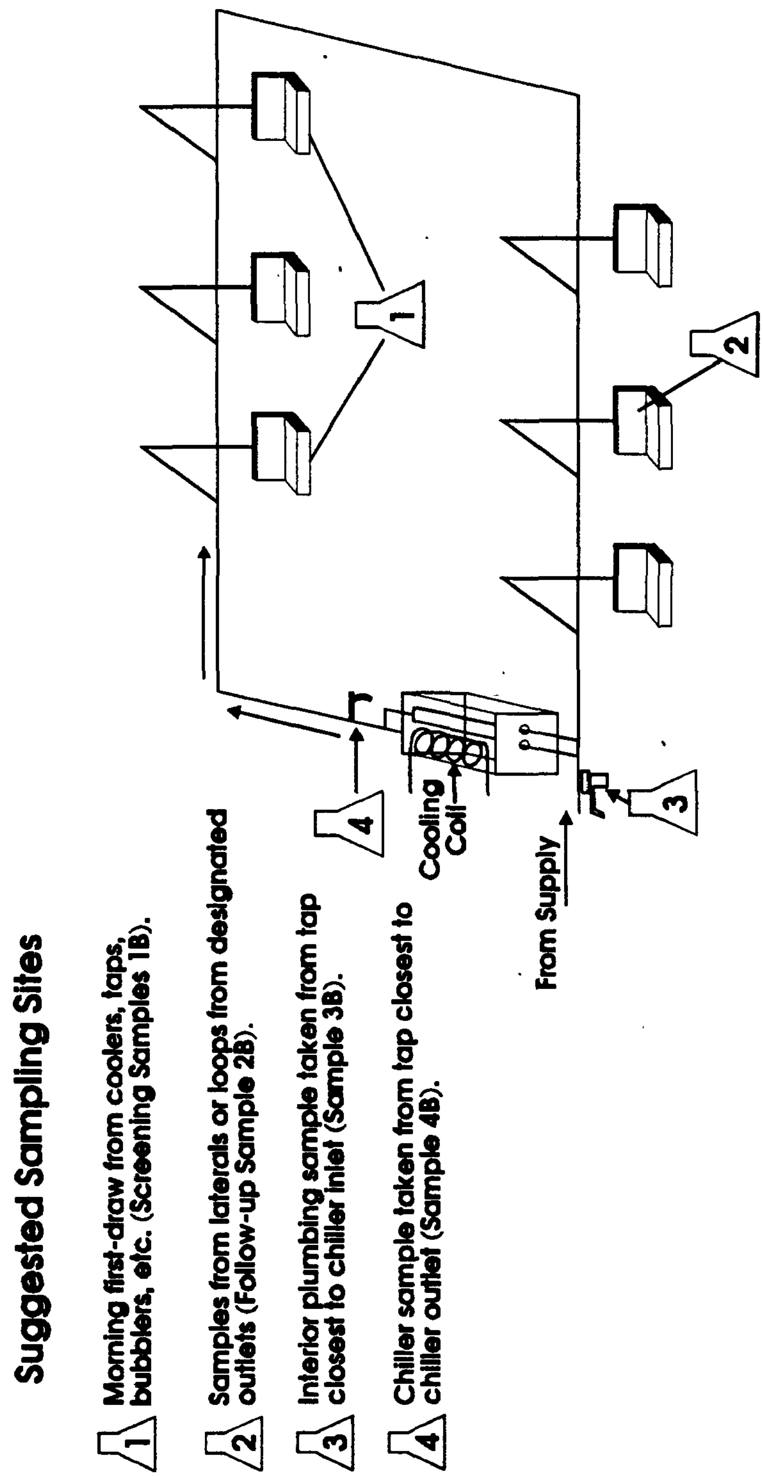


Exhibit 27 Water Supply to Water Fountains and Bubblers from Central Chiller

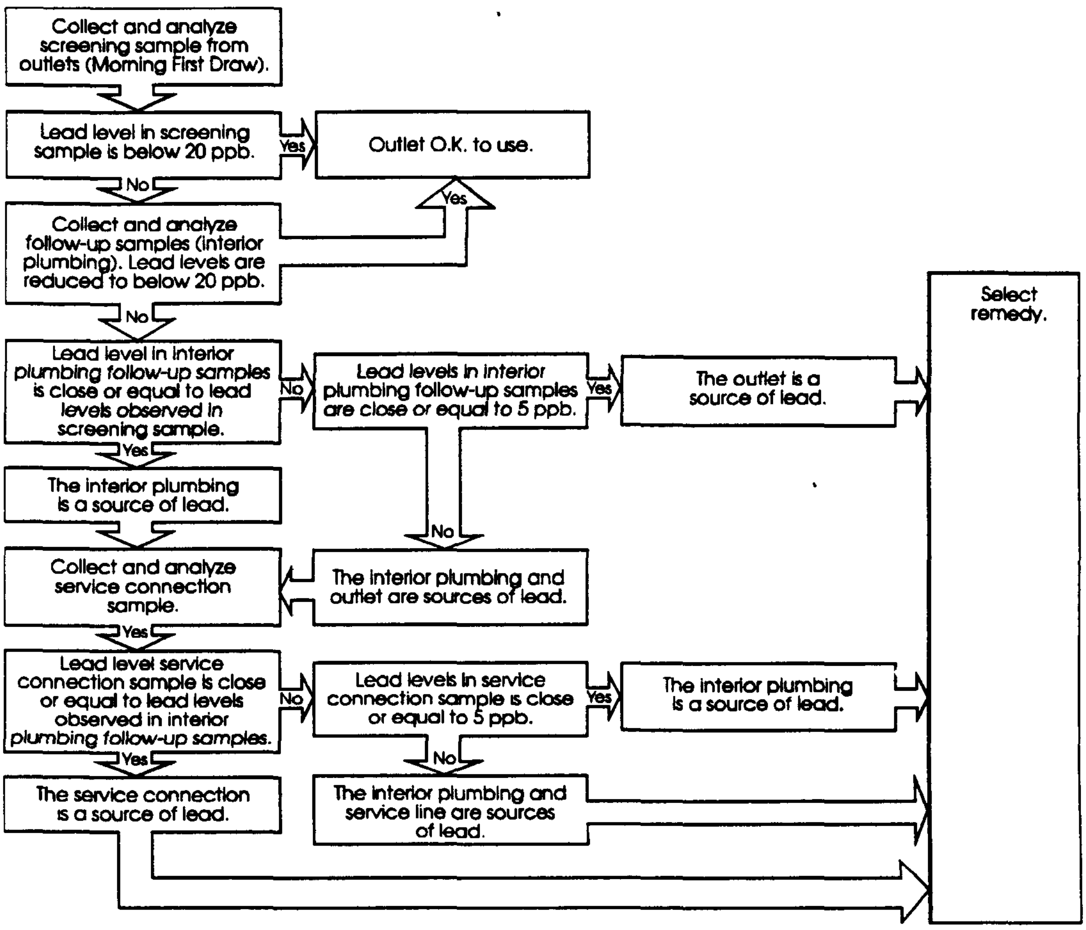


Exhibit 28 Overall Sampling Strategy

Appendix A—Directory of EPA and State Drinking Water Programs

Regional Contacts

Region I

Ms. Ellie Kwong
Groundwater Management and Water Supply Branch
U.S. Environmental Protection Agency Region I
JFK Federal Building
Boston, MA 02203
(617) 565-3620

Region II

Mr. Taj Khan
Drinking Water/Ground Water Protection Branch
U.S. Environmental Protection Agency Region II
26 Federal Plaza, Room 853
New York, NY 10278
(212) 264-1358

Region III

Mr. George Rizzo
Drinking Water/Ground Water Protection Branch
U.S. Environmental Protection Agency Region III
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-0609

Region IV

Mr. Tom DeGaetano
Municipal Facilities Branch
U.S. Environmental Protection Agency Region IV
345 Courtland Street, NE
Atlanta, GA 30365
(404) 347-2913

Region V

Mr. John Delessandro
Technical Support Unit
U.S. Environmental Protection Agency Region V
77 West Jackson
Chicago, IL 60604
(312) 353-4914

Region VI

Mr. Len Pardee
Water Supply Branch
U.S. Environmental Protection Agency Region VI
First Interstate Bank Tower at Fountain Place
1445 Ross Avenue, 12th Floor, Suite 1200
Dallas, TX 75202
(214) 655-8086

Region VII

Ms. Elizabeth Murtagh-Yaw
Drinking Water Branch
U.S. Environmental Protection Agency Region VII
726 Minnesota Avenue
Kansas City, KS 66101
(913) 551-7440

Region VIII

Ms. Marty Swickard
PWSP Section - 8WM-DW
Drinking Water Branch
U.S. Environmental Protection Agency Region VIII
999 18th Street, Suite 500
Denver, CO 80202
(303) 293-1629

Region IX

Ms. Cheryl Gustafson
Public Water Supply Section
U.S. Environmental Protection Agency Region IX
75 Hawthorne Street
San Francisco, CA 94105
(415) 744-1828

Region X

Ms. Wendy Marshall
Lead Contact WD-132
Ground Water and Drinking Water Branch
U.S. Environmental Protection Agency Region X
1200 Sixth Avenue
Seattle, WA 98101
(206) 553-1890

State LCCA Contacts

EPA REGION I

Connecticut

Mr. Bob Rivard, Supervising Sanitary Engineer
Water Supply Section
Connecticut Department of Health Services
150 Washington Street
Hartford, CT 06106
(203) 566-1253

Maine

Mr. Peter Moulton, Drinking Water Manager
Drinking Water Program
Maine Division of Health
State Station 10
Augusta, ME 04333
(207) 287-2070

Massachusetts

Mr. Chuck Larson, Environmental Engineer
Division of Water Supply
Massachusetts Department of Environmental Protection
One Winter Street
Boston, MA 02108
(617) 292-5857

New Hampshire

Mr. Richard Thayer, Sanitary Engineer
New Hampshire Department of Environmental Services
P.O. Box 95
6 Haven Drive
Concord, NH 03301
(603) 271-3139

Rhode Island

Ms. Donna Pytell, Sanitary Engineer
Division of Drinking Water Quality
Rhode Island Department of Health
3 Capitol Hill
Providence, RI 02908
(401) 277-6867

Vermont

Ms. Jean Nicolai/Benson Sargent
Drinking Water Program
Water Supply Division
Vermont Department of Health
Old Pantry Building
103 South Main Street
Waterbury, VT 05671-0403
(802) 241-3400

EPA REGION II

New Jersey

Mr. Sonny Saroya
Bureau of Safe Drinking Water
Division of Water Resources
New Jersey Department of Environmental Protection
P.O. Box CN-029
Trenton, NJ 08625
(609) 292-5550

New York

Mr. David Mead
New York Department of Health
2 University Plaza/Western Avenue
Room 406
Albany, NY 12203-3399
(518) 458-6706

Puerto Rico

Mrs. Olga I. Rivera, Acting Director
Puerto Rico Department of Health
Edificio A. Centro Medico
Call Box 70184
San Juan, PR 00936
(809) 763-4307

Virgin Islands (St. Thomas)

Mr. Ira Hobson, Supervisor, PWSS Program
Government of the Virgin IslandsDepartment of Planning and Natural Resources
Nisky Center, Suite 231, Nisky 45A
St. Thomas, VI 00802
(809) 774-3320

EPA REGION III

Delaware

Mr. Ed Hallock
Environmental Health Specialist III
Public Water System Supervision Program
Division of Public Health
Delaware Department of Health and Social Services
P.O. Box 637
Dover, DE 19901
(302) 739-5410
[Both Lead and Drinking Water Contact]

District of Columbia

Preventive Health Services
Commission of Public Health
Government of the District of Columbia
1660 L. Street, NW, Suite 815
Washington, DC 20036
(202) 673-6741
[Childhood Lead Poisoning Prevention Contact]

Maryland

Ms. Susan Guyaux
Center for Special Toxics
Lead Poisoning Prevention Program
Maryland Department of the Environment
2500 Broening Highway
Baltimore, MD 21224
(410) 631-3859
[Lead Contact]

Pennsylvania

Mr. Frederick A. Marrocco, Chief
Division of Water Supplies
Pennsylvania Department of Environmental Resources
P.O. Box 2357
Harrisburg, PA 17120
(717) 787-9037
[Both Lead and Drinking Water Contact]

Virginia

Mr. Robert B. Stroube, M.D., M.P.H.
State Health Commissioner
Virginia Department of Health
109 Governor Street
Richmond, VA 23219
(804) 786-3561
[Lead Contact]

West Virginia

Mr. Donald A. Kuntz, P.E. Director
Environmental Engineering Division
Office of Environmental Health Services
West Virginia Department of Health and Human Resources
815 Quarrier Street, Suite 418
Charleston, WV 25301
(304) 558-2981
[Both Lead and Drinking Water Contact]

EPA REGION IV

Alabama

Mr. Joe Alan Power, Director
Public Water Supply Branch
Alabama Department of Environmental Management
1751 Congressman W.L. Dickinson Drive
Montgomery, AL 36109-2698
(205) 271-7773

Florida

Mr. Van Hoofnagle, Administrator
Drinking Water Section
Florida Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400
(904) 487-1762

Georgia

Mr. Fred D. Lehman, Manager
Drinking Water Program
Georgia Department of Natural Resources
Floyd Towers East, Suite 1362
205 Butler Street, SE
Atlanta, GA 30334
(404) 651-2750

Kentucky

Mr. John T. Smither, Manager
Drinking Water Branch
Kentucky Natural Resources and
Environmental Protection Cabinet
14 Reilly Road
Frankfort, KY 40601
(502) 564-3410

Mississippi

Mr. David Mitchell, Director
Division of Water Supply
Mississippi State Department of Health
P.O. Box 1700
Jackson, MS 39205
(601) 960-7518

North Carolina

Mr. Wallace Venrick, Chief
Public Water Supply Section
North Carolina Department of Environmental Health
and Natural Resources
Division of Environmental Health
P.O. Box 29536
Raleigh, NC 27626-0536
(919) 733-2321

South Carolina

Mr. Robert E. Malpass, Chief
Bureau of Drinking Water Protection
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 733-5310

Tennessee

Mr. David Draughon, Director
Division of Water Supply
Tennessee Department of Environment and Conservation
401 Church Street
Sixth Floor, L & C Tower
Nashville, TN 37219-5404
(615) 532-0191

EPA REGION V

Illinois

Mr. Dean Thady
State Plumbing Consultant
Office of Health Protection
Illinois Department of Public Health
525 West Jefferson Street
Springfield, IL 62761
(217) 524-0799
[For questions on plumbing]

Mr. G. Michael Brant
Office of Health Protection
Division of Environmental Health
Illinois Department of Public Health
525 West Jefferson Street
Springfield, IL 62761
(217) 524-5830
[For questions on fountains in schools]

Indiana

Mr. Wayne Brattain
Drinking Water Branch
Indiana Department of Environmental Management
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 233-4179

Michigan

Division of Water Supply
Michigan Department of Public Health
3423 North Logan/Martin L. King Jr. Boulevard
P.O. Box 30195
Lansing, MI 48909
(517) 335-9215

Minnesota

Ms. Lih-In Rezania
Drinking Water Protection Section
Division of Environmental Health
Minnesota Department of Health
925 Delaware Street, SE
P.O. Box 59040
Minneapolis, MN 55459-0040
(612) 627-5488

Ohio

Mr. Dan Chatfield
Ohio Department of Health
246 North High Street
P.O. Box 118
Columbus, OH 43266-0118
(614) 466-1450

Wisconsin

Ms. Cindy Diedrich
Public Water Supply Section
Bureau of Water Supply
Wisconsin Department of Natural Resources
101 South Webster Street
P.O. Box 7921
Madison, WI 53707
(608) 267-2451

EPA REGION VI

Arkansas

Engineering Division
Arkansas Department of Health
4815 West Markham
Little Rock, AR 72203-3867
(501) 661-2623

Louisiana

Louisiana Department of Health and Hospitals
Office of Public Health
P.O. Box 60630, Room 403
New Orleans, LA 70160
(504) 568-5100

New Mexico

New Mexico Environmental Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502
(505) 827-7536

Oklahoma

Oklahoma Department of Environmental Quality
Water Quality Service-0207
1000 NE 10th Street
P.O. Box 53551
Oklahoma City, OK 73117-1212
(405) 271-5205 x148

Texas

Texas National Resource Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087
(512) 908-6020

EPA REGION VII

Iowa

Ms. Rita Gergely
Bureau of Health Engineering and Consumer Safety
Division of Disease Prevention
Iowa Department of Public Health
Lucas State Office Building
321 East 12th Street
Des Moines, IA 50319-0075
(512) 242-6340

Kansas

Contact school system for information

Missouri

Mr. Mike Carter
Bureau of Environmental Epidemiology
Missouri Department of Health
P.O. Box 570
Jefferson City, MO 65102
(314) 751-6102 or 1-800-392-7245

Nebraska

Mr. Jack Daniel, Director
Division of Drinking Water and Environmental Sanitation
Nebraska Department of Health
301 Centennial Mall South
P.O. Box 95007
Lincoln, NE 68509
(402) 471-2541

EPA REGION VIII

Colorado

Ms. Michelle Bolyard
Drinking Water Section
Water Quality Control Division
Colorado Department of Health
4300 Cherry Creek Dr. South
Denver, CO 80222
(303) 692-3539

Montana

Mr. Terry Campbell
Drinking Water Section, Water Quality Bureau
Montana Department of Health and Environmental Sciences
Cogswell Building
Helena, MT 59620
(406) 444-5256

North Dakota

Mr. Sherwin Wanner
North Dakota State Department of Health
and Consolidated Laboratories
Municipal Facilities Division
1200 Missouri Avenue, Box 5520
Bismarck, ND 58502-5520
(701) 221-5210

South Dakota

Mr. Michael Getty
South Dakota Department of Environmental
and Natural Resources
Office of Drinking Water
Joe Foss Building
Pierre, SD 57501-3181
(605) 773-3754

Utah

Ms. Patti Fauver
Utah Department of Environmental Quality
Division of Drinking Water
P.O. Box 144830
Salt Lake City, UT 84114-4830
(801) 538-6159

Wyoming

Ms. Maureen Doughtie
United States Environmental Protection Agency Region 8
PWSIE Section
999 18th Street, Suite 500
Denver, CO 80202
(303) 293-1629

EPA REGION IX

Arizona

Mr. Michael Kleminski
Compliance Officer
Drinking Water Compliance Unit
Arizona Office of Water Quality
3033 North Central Avenue
Phoenix, AZ 85012
(602) 207-4641

California

Technical Programs Branch
California Department of Health Services
Division of Drinking Water
2151 Berkeley Way, Room 113
Berkeley, CA 94704
(510) 540-2154

Hawaii

Hawaii Department of Health
Five Waterfront Plaza, Suite 250
500 Ala Moana Boulevard
Honolulu, HI 96813
(808) 586-4258

Nevada

Nevada Department of Human Resources
Bureau of Health Protection Services
505 East King Street
Carson City, NV 89710
(702) 687-4750

EPA REGION X

Alaska

Alaska Department of Environmental Conservation
Drinking Water Program Manager
410 Willoughby, Suite 105
Juneau, AK 99801
(907) 465-5300

Idaho

Mr. Eldon Nelson, Support Services Supervisor
Idaho Department of Education
650 West State
Boise, ID 83720
(208) 334-2203

Oregon

Mr. Dave Leland, Supervisor
Drinking Water Section
Oregon Health Division
P.O. Box 14450
Portland, OR 97214-0450
(503) 731-4010

Washington

Washington Department of Health
Division of Drinking Water
P.O. Box 47822
Olympia, WA 98504-7822
(206) 753-9674

Appendix B—Glossary of Terms

Bubbler: A water fountain fixture connected to the water supply. A bubbler does not contain a refrigeration unit. Some bubblers are attached to central chiller units, while others are not.

Chiller: A central refrigeration unit providing cold water to some types of bubblers.

Corrosion: A dissolving and wearing away of metal caused by a chemical reaction (e.g., between water and the piping that the water contacts).

Drinking Water Fountain: A fixture connected to the water supply that provides water as needed. There are four types of drinking water fountains: (1) bubblers without central chillers, (2) bubblers with central chillers, (3) water coolers, and (4) bottled water dispensers.

Faucet ("tap" and "fixture"): The device attached to a water dispensing apparatus (i.e., bubbler, cooler, pipe, etc.) from which the water flows. The term "faucet" is used interchangeably with the terms "tap" and "fixture."

Fittings and Valves: Any of numerous mechanical devices by which the flow of water may be started, stopped, or regulated by a movable part that opens, shuts, or partially obstructs one or more ports of passageway.

Flux: A substance applied during soldering to facilitate the flow of solder. Flux often contains lead and can itself be a source of lead contamination in water. The lead-free requirements of the 1986 Safe Drinking Water Act require that solders and flux not contain more than 0.2 percent lead.

Header: The main pipe in the internal plumbing system of a building. The header supplies water to lateral pipes.

Lateral: A plumbing branch between a fixture or group of fixtures (e.g., taps, water fountains, etc.) and the header.

Loop: A closed circuit of a plumbing branch which supplies water from the riser to a fixture or a group of fixtures.

Potable Water Pipes: The pipes in a distribution system and in a building which carry water intended for human consumption.

Public Water System: Any system that has 15 or more service connections and is in operation at least 60 days per year <u>or</u> any system serving 25 or more persons daily at least 60 days per year.

Riser: The vertical pipe that carries water from one floor to another.

Sediment: Matter from piping or other water conveyance device that settles to the bottom of the water in the apparatus. If lead components are used in plumbing materials, lead sediments may form and result in elevated water lead levels.

Service Connector: The pipe that carries tap water from the public water main to a building. In the past, these were often comprised of lead materials.

Solder: A metallic compound used to seal the joints between pipes. Until recently, most solder contained about 50 percent lead. Lead-free solders often contain one or more of the following metals: antimony, tin, copper or silver. Several alloys are available that melt and flow in a manner similar to lead solder.

Water Cooler: Any mechanical device affixed to drinking water supply plumbing that actively cools water for human consumption. The reservoir can consist of a small tank or a pipe coil.

Appendix C—Water Cooler Summary

The Lead Contamination Control Act (LCCA), which amended the Safe Drinking Water Act, was signed into law on October 31, 1988 (P.L. 100-572). The potential of water coolers to supply lead to drinking water in schools and day care centers was a principle focus of this legislation. Specifically, the LCCA mandated that the Consumer Product Safety Commission (CPSC) order the repair, replacement, or recall and refund of drinking water coolers with lead-lined water tanks. In addition, the LCCA called for a ban on the manufacture or sale in interstate commerce of drinking water coolers that are not lead-free. Civil and criminal penalties were established under the law for violations of this ban. With respect to a water cooler that may come in contact with drinking water, the LCCA defined the term "lead-free" to mean:

> "not more than 8 percent lead, except that no drinking water cooler which contains any solder, flux, or storage tank interior surface which may come in contact with drinking water shall be considered lead free if the solder, flux, or storage tank interior surface contains more than 0.2 percent lead."

Another component of the LCCA was the requirement that EPA publish and make available to the states a list of drinking water coolers, by brand and model, that are not lead-free. In addition, EPA was to publish and make available to the states a separate list of the brand and model of water coolers with a lead-lined tank. EPA is required to revise and republish these lists as new information or analyses become available.

Based on responses to a Congressional survey in the winter of 1988, three major manufacturers, the Halsey Taylor Company, EBCO Manufacturing Corporation, and Sunroc Corporation, indicated that lead solder had been used in at least some models of their drinking water coolers. On April 10, 1988, EPA proposed in the *Federal Register* (at 54 *FR* 14320) lists of drinking water coolers with lead-lined tanks and coolers that are not lead-free. Public comments were received on the notice, and the list was revised and published on January 18, 1990 (Part III, 55 *FR* 1772). *See Table C-1 for a list of water coolers with lead components.*

[1]Based on an analysis of 22 water coolers at a U.S. Navy facility and subsequent data obtained by EPA, EPA believes the most serious cooler contamination problems are associated with water coolers that have lead-lined tanks.

Prior to publication of the January 1990 list, EPA determined that Halsey Taylor was the only manufacturer of water coolers with lead-lined tanks.[1] Table C-2 presents a listing of model numbers of the Halsey Taylor drinking water coolers with lead-lined tanks that had been identified by EPA as of January 18, 1990.

Since the LCCA required the CPSC to order manufacturers of coolers with lead-lined tanks to repair, replace or recall and provide a refund of such coolers, the CPSC negotiated such an agreement with Halsey Taylor through a consent order published on June 1, 1990 (at 55 *FR* 22387). The consent agreement calls on Halsey Taylor to provide a replacement or refund program that addresses all the water coolers listed in Table C-2 as well as "all tank-type models of drinking water coolers manufactured by Halsey Taylor, whether or not those models are included on the present or on a future EPA list." Under the consent order, Halsey Taylor agreed to notify the public of the replacement and refund program for all tank type models.

If you have one of the Halsey Taylor water coolers noted in Table C-2, contact Halsey Taylor *(address and phone noted below)* to learn more about the requirements surrounding their replacement and refund program.

Halsey Taylor
2222 Camden Court
Oak Brook, IL 60520
(708) 574-3500

SPECIAL NOTE:

Experience indicates that newly installed brass plumbing components containing 8 percent or less lead, as allowed by the LCCA and the Lead Ban, can contribute high lead levels to drinking water for a considerable period after installation. U.S. water cooler manufacturers have notified EPA that since September 1993, the components of water coolers that come in contact with drinking water have been made with non-lead alloy materials. These materials include stainless steel for fittings and water control devices, brass made of 60 percent copper and 40 percent zinc, terillium copper, and food grade plastic.

Table C-1
Water Coolers With Other Lead Components

EBCO Manufacturing

- All pressure bubbler water coolers with shipping dates from 1962 through 1977 have a bubbler valve containing lead. The units contain a single, 50-50 tin-lead solder joint on the bubbler valve. Model numbers for coolers in this category are not available.

- The following models of pressure bubbler coolers produced from 1978 through 1981 contain one 50-50 tin-lead solder joint each.

CP3	DP15W	DPM8	7P	13P	DPM8H	DP15M	DP3R	DP8A
DP16M	DP5S	C10E	PX-10	DP7S	DP13SM	DP7M	DP7MH	DP7WD
WTC10	DP13M-60	DP14M	CP10-50	CP5	CP5M	DP15MW	DP3R	DP14S
DP20-50	DP7SM	DP10X	DP13A	DP13A-50	EP10F	DP5M	DP10F	CP3H
CP3-50	DP13M	DP3RH	DP5F	CP3M	EP5F	13PL	DP8AH	DP13S
CP10	DP20	DP12N	DP7WM	DP14A-50/60				

Halsey Taylor

- Lead solder was used in these models of water coolers manufactured between 1978 and the last week of 1987:

WMA-1	SCWT/SCWT-A	SWA-1	DC/DHC-1
S3/5/10D	BFC-4F/7F/4FS/7FS	S300/500/100D	

- The following coolers manufactured for Haws Drinking Faucet Company (Haws) by Halsey Taylor from November 1984 through December 18, 1987 are not lead-free because they contain 2 tin-lead solder joints. The model designations for these units are as follows:

HC8WT	HC14F	HC6W	HWC7D	HC8WTH	HC14FH	HC8W	HC2F	HC14WT
HC14FL	HC14W	HC2FH	HC14WTH	HC8FL	HC4F	HC5F	HC14WL	HCBF7D
HC4FH	HC10F	HC16WT	HCBF7HO	HC8F	HC8FH	HC4W	HWC7	

Table C-2
Halsey Taylor Water Coolers With Lead-Lined Tanks

- The following six model numbers have one or more units in the model series with lead-lined tanks:

WM8A	WT8A	GC10ACR	GC10A	GC5A	RWM13A

- The following models and serial numbers contain lead-lined tanks:

WM14A Serial No. 843034	WM14A Serial No. 843006	WT11A Serial No. 222650
WT21A Serial No. 64309550	WT21A Serial No. 64309542	LL14A Serial No. 64346908

Appendix D—List of Lead Resources

Publications

Unless otherwise specified, these publications can be ordered from the EPA National Safe Drinking Water Hotline listed below.

Lead and Your Drinking Water (booklet), U.S. EPA Office of Ground Water and Drinking Water, EPA 810/F-93-001, April 1987.

Lead Contamination Control Act (P.L. 100-572) (Federal statute) and supporting documents available through House Document Room, House of Representatives, Washington, DC 20515 (202) 225-3456.

Lead Contamination Control Act (LCCA) (pamphlet), U.S. EPA Office of Ground Water and Drinking Water, EPA 570/9-89-AAA, August 1989.

Lead in Drinking Water in Schools and Non-Residential Buildings (manual), US EPA Office Of Ground Water and Drinking Water, EPA 812-B-94-002, April 1994.

Sampling for Lead in Drinking Water in Nursery Schools and Day Care Facilities (booklet), US EPA Office of Ground Water and Drinking Water 812-B-94-003, April 1994.

The Lead Ban: Preventing the Use of Lead in Public Water Systems and Plumbing Used for Drinking Water (pamphlet on the Federal lead ban), U.S. EPA Office of Ground Water and Drinking Water, EPA 570/9-89-BBB, August 1989.

***Federal Register* Notices on Water Coolers:**

(1) April 10, 1989, Part II, 54 *FR* 14316
Explanation of the LCCA and availability of guidance document.

(2) April 10, 1989, Part III, 54 *FR* 14320
Proposed list of water coolers that are not lead-free.

(3) January 18, 1990, Part III, 55 *FR* 1772
Final and proposed list of water coolers that are not lead-free.

(4) June 1, 1990, 55 *FR* 22387
Notice of Halsey Taylor consent order agreement.

EPA National Safe Drinking Water Hotline

(800) 426-4791.

Hotline operates Monday through Friday, 9:00 am to 5:30 pm (EST), except Federal holidays.

Appendix E— Sample Recordkeeping Form

Record of Sampling

Name of Building

Name of Sample Collector

Contact Person for this Record

Sample ID Number

(circle sample type) Service Connection Initial 1st Follow-up 2nd Follow-up

Length of Flush

Type of Outlet

Mfg/Model

Serial #

Date of Installation / /

Location

Date of Collection / /

Time of Collection am pm

Name of Laboratory Used

Lead Concentration (ppb)

NOTES:

Appendix F—Preservation of Samples and Sample Containers

This appendix contains information pertaining to the preservation of samples and sample containers. If you plan to use a certified drinking water laboratory to conduct analyses of your samples, they should be aware of these requirements. In addition, they will provide you with actual samplers or sample containers and instructions. The sample containers will have been prepared prior to your receipt. The lab will also specify how to handle the sample containers and when to submit them after taking your samples.

Contamination of sample containers by dust, dirt or other impurities containing lead can produce inaccurate test results in an otherwise conscientious sampling program. Contamination of a water sample by the container may indicate higher lead levels than are actually present in the drinking water.

Another source of error that may affect the results of analyses is the adsorption of lead from the water onto the surface of the container, which will reduce the amount of lead in the water sample. In such instances, analytical results will indicate lower lead levels in the sample than actually are present.

In order to avoid analytical errors, pay particular attention to proper collection and handling of the sample before analysis. Preparation of sample containers is described in detail in an EPA manual entitled, *Methods for Chemical Analysis of Water and Wastes*. In brief, the sample container, whether borosilicate glass, polyethylene, polyproplyene or Teflon should be thoroughly washed with detergent and tap water, rinsed with 1:1 nitric acid and tap water, 1:1 hydrochloric acid and tap water, and finally deionized distilled water—in that order.

Make sure the containers are kept sealed between the time of their preparation and the collection of the sample. This will assure that no contaminants from the outside are introduced. In order to avoid the loss of lead from the sample through adsoprtion onto the sample container wall, the sample will need to be acidified with concentrated nitric acid to a pH of less than 2. If the nitric acid cannot be used at the time of the collection of the sample because of shipping restrictions, preserve the sample by icing and promptly ship it to the laboratory. Upon receipt, the laboratory will acidify the sample. The sample can be held up to 14 days prior to acidification without loss of lead through absorption.

For more detailed information, refer to the following EPA manuals:

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, revised edition, March 1983 (available from U.S. EPA, R&D Publications, 26 West Martin Luther King Blvd., Cincinnati, OH 45268).

Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991 (available from the National Technical Information Service, Pub. No. PB91-231498 (703) 487-4650).

Manual for the Certification of Laboratories Analyzing Drinking Water, EPA-570/9-90/008, April 1990 (available from the National Technical Information Service, (703) 487-4650).